

# MC74HCT138A

## 1-of-8 Decoder/ Demultiplexer with LSTTL Compatible Inputs

### High-Performance Silicon-Gate CMOS

The MC74HCT138A is identical in pinout to the LS138. The HCT138A may be used as a level converter for interfacing TTL or NMOS outputs to High Speed CMOS inputs.

The HCT138A decodes a three-bit Address to one-of-eight active-low outputs. This device features three Chip Select inputs, two active-low and one active-high to facilitate the demultiplexing, cascading, and chip-selecting functions. The demultiplexing function is accomplished by using the Address inputs to select the desired device output; one of the Chip Selects is used as a data input while the other Chip Selects are held in their active states.

#### Features

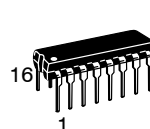
- Output Drive Capability: 10 LSTTL Loads
- TTL/NMOS Compatible Input Levels
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 4.5 to 5.5 V
- Low Input Current: 1.0  $\mu$ A
- In Compliance with the Requirements Defined by JEDEC Standard No. 7A
- Chip Complexity: 122 FETs or 30.5 Equivalent Gates
- Pb-Free Packages are Available\*



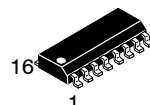
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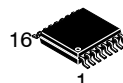
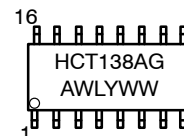
#### MARKING DIAGRAMS



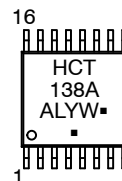
PDIP-16  
N SUFFIX  
CASE 648



SOIC-16  
D SUFFIX  
CASE 751B



TSSOP-16  
DT SUFFIX  
CASE 948F



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)

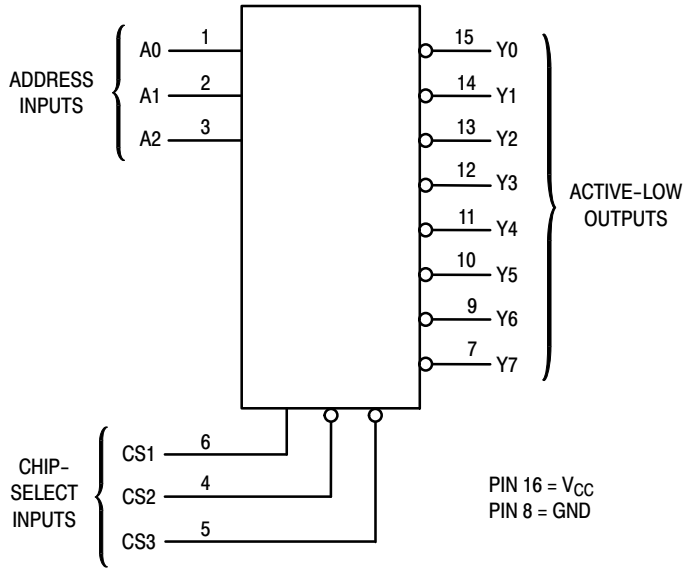
#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 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.

# MC74HCT138A

## LOGIC DIAGRAM



## PIN ASSIGNMENT

|     |   |    |          |
|-----|---|----|----------|
| A0  | 1 | 16 | $V_{CC}$ |
| A1  | 2 | 15 | Y0       |
| A2  | 3 | 14 | Y1       |
| CS2 | 4 | 13 | Y2       |
| CS3 | 5 | 12 | Y3       |
| CS1 | 6 | 11 | Y4       |
| Y7  | 7 | 10 | Y5       |
| GND | 8 | 9  | Y6       |

## FUNCTION TABLE

| Inputs |     |     |    |    |    | Outputs |    |    |    |    |    |    |    |
|--------|-----|-----|----|----|----|---------|----|----|----|----|----|----|----|
| CS1    | CS2 | CS3 | A2 | A1 | A0 | Y0      | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
| X      | X   | H   | X  | X  | X  | H       | H  | H  | H  | H  | H  | H  | H  |
| X      | H   | X   | X  | X  | X  | H       | H  | H  | H  | H  | H  | H  | H  |
| L      | X   | X   | X  | X  | X  | H       | H  | H  | H  | H  | H  | H  | H  |
| H      | L   | L   | L  | L  | L  | L       | H  | H  | H  | H  | H  | H  | H  |
| H      | L   | L   | L  | L  | H  | H       | L  | H  | H  | H  | H  | H  | H  |
| H      | L   | L   | L  | H  | L  | H       | H  | L  | H  | H  | H  | H  | H  |
| H      | L   | L   | L  | H  | H  | H       | H  | L  | H  | H  | H  | H  | H  |
| H      | L   | L   | H  | L  | L  | H       | H  | H  | H  | L  | H  | H  | H  |
| H      | L   | L   | H  | H  | L  | H       | H  | H  | H  | H  | L  | H  | H  |
| H      | L   | L   | H  | H  | H  | H       | H  | H  | H  | H  | H  | L  | H  |

H = high level (steady state)

L = low level (steady state)

X = don't care

| Design Criteria                 | Value | Units   |
|---------------------------------|-------|---------|
| Internal Gate Count*            | 30.5  | ea.     |
| Internal Gate Propagation Delay | 1.5   | ns      |
| Internal Gate Power Dissipation | 5.0   | $\mu W$ |
| Speed Power Product             | .0075 | pJ      |

\*Equivalent to a two-input NAND gate.

## ORDERING INFORMATION

| Device          | Package              | Shipping <sup>†</sup>    |
|-----------------|----------------------|--------------------------|
| MC74HCT138ANG   | PDIP-16<br>(Pb-Free) | 500 Units / Box          |
| MC74HCT138ADG   | SOIC-16<br>(Pb-Free) | 48 Units / Rail          |
| MC74HCT138ADR2G | SOIC-16<br>(Pb-Free) | 2500 Units / Tape & Reel |
| MC74HCT138ADTR2 | TSSOP-16*            | 2500 Units / Tape & Reel |

<sup>†</sup>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.

# MC74HCT138A

## MAXIMUM RATINGS

| Symbol    | Parameter                                                                               | Value                   | Unit |
|-----------|-----------------------------------------------------------------------------------------|-------------------------|------|
| $V_{CC}$  | DC Supply Voltage (Referenced to GND)                                                   | – 0.5 to + 7.0          | V    |
| $V_{in}$  | DC Input Voltage (Referenced to GND)                                                    | – 0.5 to $V_{CC} + 0.5$ | V    |
| $V_{out}$ | DC Output Voltage (Referenced to GND)                                                   | – 0.5 to $V_{CC} + 0.5$ | V    |
| $I_{in}$  | DC Input Current, per Pin                                                               | $\pm 20$                | mA   |
| $I_{out}$ | DC Output Current, per Pin                                                              | $\pm 25$                | mA   |
| $I_{CC}$  | DC Supply Current, $V_{CC}$ and GND Pins                                                | $\pm 50$                | mA   |
| $P_D$     | Power Dissipation in Still Air<br>Plastic DIP†<br>SOIC Package†<br>TSSOP Package†       | 750<br>500<br>450       | mW   |
| $T_{stg}$ | Storage Temperature                                                                     | – 65 to + 150           | °C   |
| $T_L$     | Lead Temperature, 1 mm from Case for 10 Seconds<br>(Plastic DIP, TSSOP or SOIC Package) | 260                     | °C   |

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.

†Derating — Plastic DIP: – 10 mW/°C from 65° to 125°C  
SOIC Package: – 7 mW/°C from 65° to 125°C  
TSSOP Package: – 6.1 mW/°C from 65° to 125°C

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.

## RECOMMENDED OPERATING CONDITIONS

| Symbol            | Parameter                                            | Min  | Max      | Unit |
|-------------------|------------------------------------------------------|------|----------|------|
| $V_{CC}$          | DC Supply Voltage (Referenced to GND)                | 4.5  | 5.5      | V    |
| $V_{in}, V_{out}$ | DC Input Voltage, Output Voltage (Referenced to GND) | 0    | $V_{CC}$ | V    |
| $T_A$             | Operating Temperature, All Package Types             | – 55 | + 125    | °C   |
| $t_r, t_f$        | Input Rise and Fall Time (Figure 1)                  | 0    | 500      | ns   |

## DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

| Symbol           | Parameter                                      | Test Conditions                                                                                                             | V <sub>CC</sub><br>V | Guaranteed Limit |               |            | Unit |
|------------------|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|----------------------|------------------|---------------|------------|------|
|                  |                                                |                                                                                                                             |                      | – 55 to 25°C     | ≤ 85°C        | ≤ 125°C    |      |
| V <sub>IH</sub>  | Minimum High-Level Input Voltage               | V <sub>out</sub> = 0.1 V or V <sub>CC</sub> – 0.1 V<br> I <sub>out</sub>   ≤ 20 μA                                          | 4.5<br>5.5           | 2.0<br>2.0       | 2.0<br>2.0    | 2.0<br>2.0 | V    |
| V <sub>IL</sub>  | Maximum Low-Level Input Voltage                | V <sub>out</sub> = 0.1 V or V <sub>CC</sub> – 0.1 V<br> I <sub>out</sub>   ≤ 20 μA                                          | 4.5<br>5.5           | 0.8<br>0.8       | 0.8<br>0.8    | 0.8<br>0.8 | V    |
| V <sub>OH</sub>  | Minimum High-Level Output Voltage              | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 20 μA                                         | 4.5<br>5.5           | 4.4<br>5.4       | 4.4<br>5.4    | 4.4<br>5.4 | V    |
|                  |                                                | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 4.0 mA                                        | 4.5                  | 3.98             | 3.84          | 3.7        |      |
| 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>out</sub>   ≤ 20 μA                                         | 4.5<br>5.5           | 0.1<br>0.1       | 0.1<br>0.1    | 0.1<br>0.1 | V    |
|                  |                                                | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 4.0 mA                                        | 4.5                  | 0.26             | 0.33          | 0.4        |      |
| I <sub>in</sub>  | Maximum Input Leakage Current                  | V <sub>in</sub> = V <sub>CC</sub> or GND                                                                                    | 6.0                  | ± 0.1            | ± 1.0         | ± 1.0      | μA   |
| I <sub>CC</sub>  | Maximum Quiescent Supply Current (per Package) | V <sub>in</sub> = V <sub>CC</sub> or GND<br>I <sub>out</sub> = 0 μA                                                         | 5.5                  | 4.0              | 40            | 160        | μA   |
| ΔI <sub>CC</sub> | Additional Quiescent Supply Current            | V <sub>in</sub> = 2.4 V, Any One Input<br>V <sub>in</sub> = V <sub>CC</sub> or GND, Other Inputs<br>I <sub>out</sub> = 0 μA | 5.5                  | ≥ – 55°C         | 25°C to 125°C |            | mA   |
|                  |                                                |                                                                                                                             |                      | 2.9              | 2.4           |            |      |

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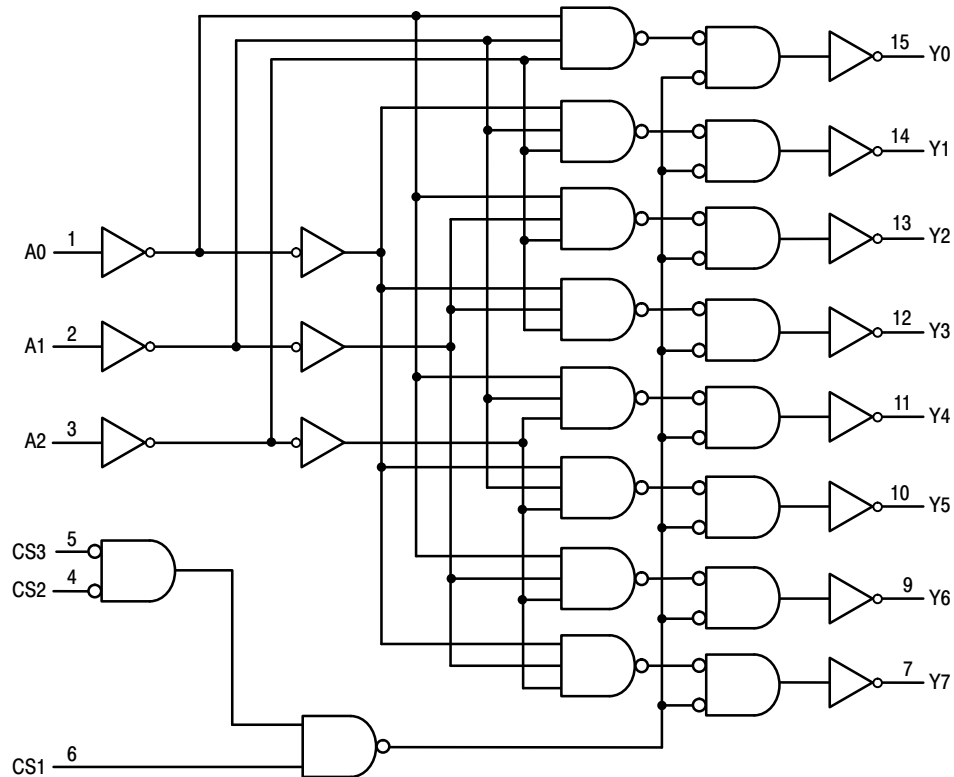
## AC ELECTRICAL CHARACTERISTICS ( $V_{CC} = 5.0 \text{ V} \pm 10\%$ , $C_L = 50 \text{ pF}$ , Input $t_r = t_f = 6.0 \text{ ns}$ )

| Symbol                                 | Parameter                                                                   | Guaranteed Limit |        |         | Unit |
|----------------------------------------|-----------------------------------------------------------------------------|------------------|--------|---------|------|
|                                        |                                                                             | – 55 to 25°C     | ≤ 85°C | ≤ 125°C |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay, Input A to Output Y<br>(Figures 1 and 4)         | 30               | 38     | 45      | ns   |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay, CS1 to Output Y<br>(Figures 2 and 4)             | 27               | 34     | 41      | ns   |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Output Transition Time, CS2 or CS3 to Output Y<br>(Figures 3 and 4) | 30               | 38     | 45      | ns   |
| t <sub>TLH</sub> ,<br>t <sub>THL</sub> | Maximum Output Transition Time, Any Output<br>(Figures 2 and 4)             | 15               | 19     | 22      | ns   |
| t <sub>r</sub> , t <sub>f</sub>        | Maximum Input Rise and Fall Time                                            | 500              | 500    | 500     | ns   |
| C <sub>in</sub>                        | Maximum Input Capacitance                                                   | 10               | 10     | 10      | pF   |

|                 |                                                     |                                         |    |
|-----------------|-----------------------------------------------------|-----------------------------------------|----|
| C <sub>PD</sub> | Power Dissipation Capacitance (Per Enabled Output)* | Typical @ 25°C, V <sub>CC</sub> = 5.0 V | pF |
|                 |                                                     | 51                                      |    |

\* Used to determine the no-load dynamic power consumption:  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ .

## EXPANDED LOGIC DIAGRAM



# MC74HCT138A

## SWITCHING WAVEFORMS

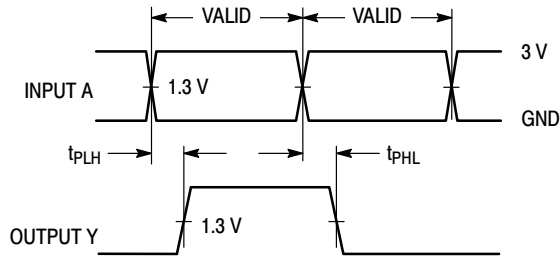


Figure 1.

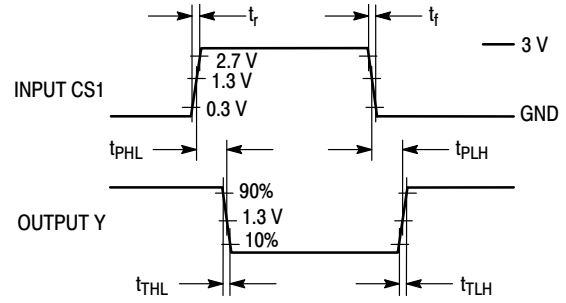


Figure 2.

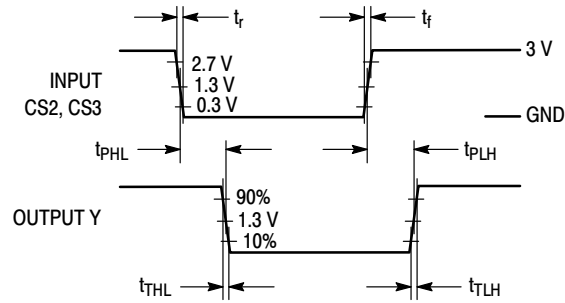
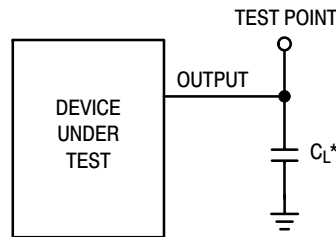


Figure 3.

## TEST CIRCUIT



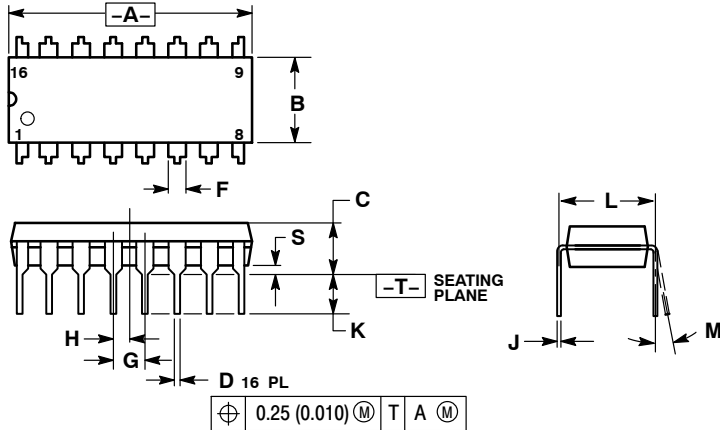
\*Includes all probe and jig capacitance

Figure 4.

# MC74HCT138A

## PACKAGE DIMENSIONS

PDIP-16  
N SUFFIX  
CASE 648-08  
ISSUE T

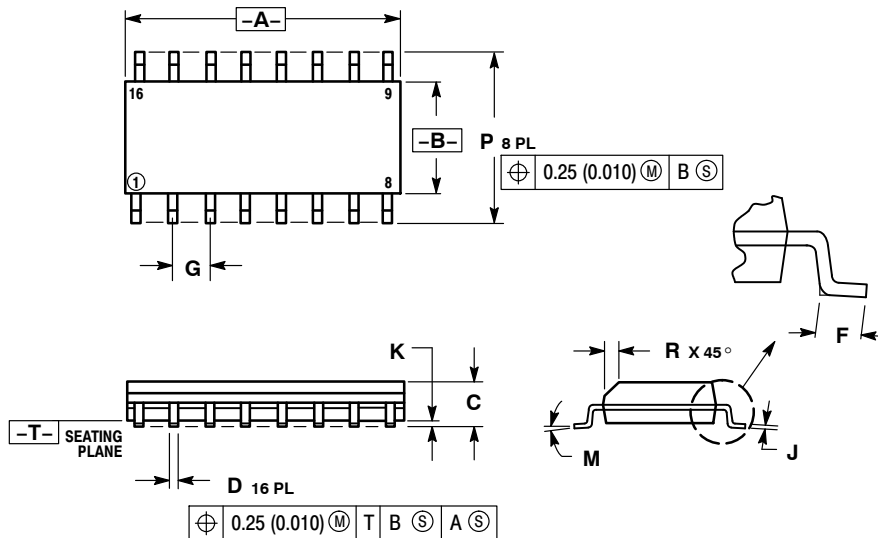


### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.740     | 0.770 | 18.80       | 19.55 |
| B   | 0.250     | 0.270 | 6.35        | 6.85  |
| C   | 0.145     | 0.175 | 3.69        | 4.44  |
| D   | 0.015     | 0.021 | 0.39        | 0.53  |
| F   | 0.040     | 0.70  | 1.02        | 1.77  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.050 BSC |       | 1.27 BSC    |       |
| J   | 0.008     | 0.015 | 0.21        | 0.38  |
| K   | 0.110     | 0.130 | 2.80        | 3.30  |
| L   | 0.295     | 0.305 | 7.50        | 7.74  |
| M   | 0°        | 10°   | 0°          | 10°   |
| S   | 0.020     | 0.040 | 0.51        | 1.01  |

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 |

## PACKAGE DIMENSIONS

Figure 1 is a mechanical drawing of a 16-pin connector. The drawing includes a top view, a side view, and two detail views (DETAIL E).

**Top View:** The top view shows a rectangular component with 16 pins. The pins are labeled 1 through 16. The dimensions are: Length  $L$ , Width  $B$ , and Pin Pitch  $A$ . A 16X K REF dimension is shown. The drawing includes various tolerances and surface finish symbols.

**Side View:** The side view shows the component's profile. The dimensions are: Height  $C$ , Width  $D$ , and Pin Pitch  $G$ .

**DETAIL E:** Two detail views (DETAIL E) are shown. The first detail E shows the pin profile with dimensions  $N$ ,  $M$ ,  $F$ , and a  $0.25 (0.010)$  dimension. The second detail E shows the pin profile with dimensions  $J$ ,  $J1$ ,  $K$ , and  $K1$ .

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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Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

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