

MC14049UB

Hex Buffers

The MC14049UB hex inverter/buffer is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. This complementary MOS device finds primary use where low power dissipation and/or high noise immunity is desired. This device provides logic-level conversion using only one supply voltage, V_{DD} . The input-signal high level (V_{IH}) can exceed the V_{DD} supply voltage for logic-level conversions. Two TTL/DTL Loads can be driven when the device is used as CMOS-to-TTL/DTL converters ($V_{DD} = 5.0\text{ V}$, $V_{OL} \leq 0.4\text{ V}$, $I_{OL} \geq 3.2\text{ mA}$). Note that pins 13 and 16 are not connected internally on this device; consequently connections to these terminals will not affect circuit operation.

- High Source and Sink Currents
- High-to-Low Level Converter
- Supply Voltage Range = 3.0 V to 18 V
- Meets JEDEC UB Specifications
- V_{IN} can exceed V_{DD}
- Improved ESD Protection on All Inputs

MAXIMUM RATINGS (Voltages Referenced to V_{SS}) (Note 2.)

| Symbol | Parameter | Value | Unit |
|-----------|--|------------------------|--------------------|
| V_{DD} | DC Supply Voltage Range | -0.5 to +18.0 | V |
| V_{in} | Input Voltage Range (DC or Transient) | -0.5 to +18.0 | V |
| V_{out} | Output Voltage Range (DC or Transient) | -0.5 to $V_{DD} + 0.5$ | V |
| I_{in} | Input Current (DC or Transient) per Pin | ± 10 | mA |
| I_{out} | Output Current (DC or Transient) per Pin | +45 | mA |
| P_D | Power Dissipation, per Package (Note 3.) | | mW |
| | Plastic | 825 | |
| | SOIC | 740 | |
| T_A | Ambient Temperature Range | -55 to +125 | $^{\circ}\text{C}$ |
| T_{stg} | Storage Temperature Range | -65 to +150 | $^{\circ}\text{C}$ |
| T_L | Lead Temperature (8-Second Soldering) | 260 | $^{\circ}\text{C}$ |

- Maximum Ratings are those values beyond which damage to the device may occur.
- Temperature Derating:
All Packages: See Figure 4.

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields referenced to the V_{SS} pin, only. Extra precautions must be taken to avoid applications of any voltage higher than the maximum rated voltages to this high-impedance circuit. For proper operation, the ranges $V_{SS} \leq V_{in} \leq 18\text{ V}$ and $V_{SS} \leq V_{out} \leq V_{DD}$ are recommended.

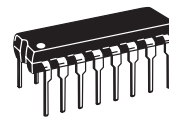
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.



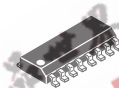
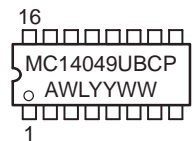
ON Semiconductor

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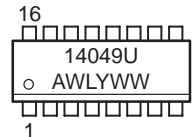
MARKING DIAGRAMS



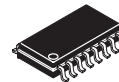
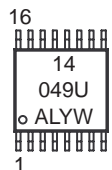
PDIP-16
P SUFFIX
CASE 648



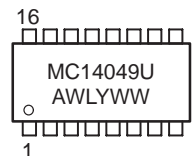
SOIC-16
D SUFFIX
CASE 751B



TSSOP-16
DT SUFFIX
CASE 948F



SOEIAJ-16
F SUFFIX
CASE 966



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

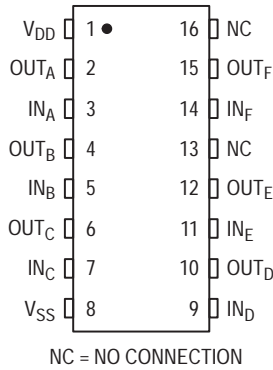
ORDERING INFORMATION

| Device | Package | Shipping |
|---------------|-----------|------------------|
| MC14049UBCP | PDIP-16 | 2000/Box |
| MC14049UBD | SOIC-16 | 2400/Box |
| MC14049UBDR2 | SOIC-16 | 2500/Tape & Reel |
| MC14049UBDT | TSSOP-16 | 96/Rail |
| MC14049UBDTR2 | TSSOP-16 | 2500/Tape & Reel |
| MC14049UBF | SOEIAJ-16 | See Note 1. |
| MC14049UBFEL | SOEIAJ-16 | See Note 1. |

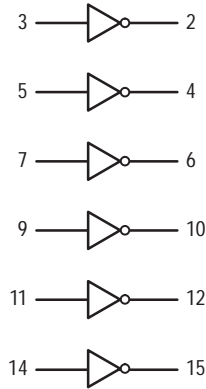
- For ordering information on the EIAJ version of the SOIC packages, please contact your local ON Semiconductor representative.

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PIN ASSIGNMENT

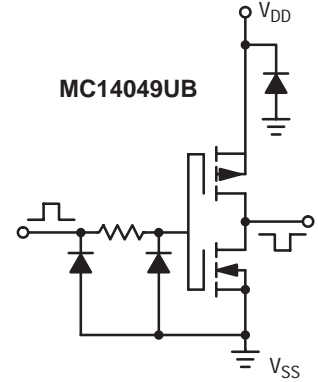


LOGIC DIAGRAM MC14049UB



NC = PIN 13, 16
V_{SS} = PIN 8
V_{DD} = PIN 1

CIRCUIT SCHEMATIC (1/6 OF CIRCUIT SHOWN)



ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

| Characteristic | Symbol | V _{DD} Vdc | -55 °C | | 25 °C | | | 125 °C | | Unit | |
|---|---|------------------------|---|-------|-------|---------------------|------|--------|-------|------------------|------------------|
| | | | Min | Max | Min | Typ ^(4.) | Max | Min | Max | | |
| Output Voltage V _{in} = V _{DD} or 0 | "0" Level | V _{OL} | 5.0 | — | 0.05 | — | 0 | 0.05 | — | 0.05 | Vdc |
| | | | 10 | — | 0.05 | — | 0 | 0.05 | — | 0.05 | |
| | | | 15 | — | 0.05 | — | 0 | 0.05 | — | 0.05 | |
| | "1" Level V _{in} = 0 or V _{DD} | V _{OH} | 5.0 | 4.95 | — | 4.95 | 5.0 | — | 4.95 | — | Vdc |
| | | | 10 | 9.95 | — | 9.95 | 10 | — | 9.95 | — | |
| | | | 15 | 14.95 | — | 14.95 | 15 | — | 14.95 | — | |
| Input Voltage (V _O = 4.5 Vdc) (V _O = 9.0 Vdc) (V _O = 13.5 Vdc) | "0" Level | V _{IL} | 5.0 | — | 1.0 | — | 2.25 | 1.0 | — | 1.0 | Vdc |
| | | | 10 | — | 2.0 | — | 4.50 | 2.0 | — | 2.0 | |
| | | | 15 | — | 2.5 | — | 6.75 | 2.5 | — | 2.5 | |
| | "1" Level | V _{IH} | 5.0 | 4.0 | — | 4.0 | 2.75 | — | 4.0 | — | Vdc |
| | | | 10 | 8.0 | — | 8.0 | 5.50 | — | 8.0 | — | |
| | | | 15 | 12.5 | — | 12.5 | 8.25 | — | 12.5 | — | |
| Output Drive Current (V _{OH} = 2.5 Vdc) (V _{OH} = 9.5 Vdc) (V _{OH} = 13.5 Vdc) | Source | I _{OH} | 5.0 | -1.6 | — | -1.25 | -2.5 | — | -1.0 | — | mA _{dc} |
| | | | 10 | -1.6 | — | -1.3 | -2.6 | — | -1.0 | — | |
| | | | 15 | -4.7 | — | -3.75 | -10 | — | -3.0 | — | |
| | Sink | I _{OL} | 5.0 | 3.75 | — | 3.2 | 6.0 | — | 2.6 | — | mA _{dc} |
| | | | 10 | 10 | — | 8.0 | 16 | — | 6.6 | — | |
| | | | 15 | 30 | — | 24 | 40 | — | 19 | — | |
| Input Current | I _{in} | 15 | — | ±0.1 | — | ±0.00001 | ±0.1 | — | ±1.0 | μA _{dc} | |
| Input Capacitance (V _{in} = 0) | C _{in} | — | — | — | — | 10 | 20 | — | — | pF | |
| Quiescent Current (Per Package) | I _{DD} | 5.0 | — | 1.0 | — | 0.002 | 1.0 | — | 30 | μA _{dc} | |
| | | 10 | — | 2.0 | — | 0.004 | 2.0 | — | 60 | | |
| | | 15 | — | 4.0 | — | 0.006 | 4.0 | — | 120 | | |
| Total Supply Current ^(5.) ^(6.) (Dynamic plus Quiescent, Per Package) (C _L = 50 pF on all outputs, all buffers switching) | I _T | 5.0 | I _T = (1.8 μA/kHz) f + I _{DD} | | | | | | | μA _{dc} | |
| | | 10 | I _T = (3.5 μA/kHz) f + I _{DD} | | | | | | | | |
| | | 15 | I _T = (5.3 μA/kHz) f + I _{DD} | | | | | | | | |

4. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

5. The formulas given are for the typical characteristics only at 25 °C.

6. To calculate total supply current at loads other than 50 pF:

$$I_T(C_L) = I_T(50 \text{ pF}) + (C_L - 50) \text{ Vfk}$$

where: I_T is in μA (per package), C_L in pF, V = (V_{DD} - V_{SS}) in volts, f in kHz is input frequency, and k = 0.002.

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SWITCHING CHARACTERISTICS (7.) ($C_L = 50 \text{ pF}$, $T_A = 25^\circ\text{C}$)

| Characteristic | Symbol | V_{DD} Vdc | Min | Typ (8.) | Max | Unit |
|--|-----------|-----------------|-------------|-----------------|------------------|------|
| Output Rise Time $t_{TLH} = (0.8 \text{ ns/pF}) C_L + 60 \text{ ns}$ $t_{TLH} = (0.3 \text{ ns/pF}) C_L + 35 \text{ ns}$ $t_{TLH} = (0.27 \text{ ns/pF}) C_L + 26.5 \text{ ns}$ | t_{TLH} | 5.0 10 15 | — — — | 100 50 40 | 160 100 60 | ns |
| Output Fall Time $t_{THL} = (0.3 \text{ ns/pF}) C_L + 25 \text{ ns}$ $t_{THL} = (0.12 \text{ ns/pF}) C_L + 14 \text{ ns}$ $t_{THL} = (0.1 \text{ ns/pF}) C_L + 10 \text{ ns}$ | t_{THL} | 5.0 10 15 | — — — | 40 20 15 | 60 40 30 | ns |
| Propagation Delay Time $t_{PLH} = (0.38 \text{ ns/pF}) C_L + 61 \text{ ns}$ $t_{PLH} = (0.20 \text{ ns/pF}) C_L + 30 \text{ ns}$ $t_{PLH} = (0.11 \text{ ns/pF}) C_L + 24.5 \text{ ns}$ | t_{PLH} | 5.0 10 15 | — — — | 80 40 30 | 120 65 50 | ns |
| Propagation Delay Time $t_{PHL} = (0.38 \text{ ns/pF}) C_L + 11 \text{ ns}$ $t_{PHL} = (0.12 \text{ ns/pF}) C_L + 9 \text{ ns}$ $t_{PHL} = (0.11 \text{ ns/pF}) C_L + 4.5 \text{ ns}$ | t_{PHL} | 5.0 10 15 | — — — | 30 15 10 | 60 30 20 | ns |

7. The formulas given are for the typical characteristics only at 25°C .

8. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

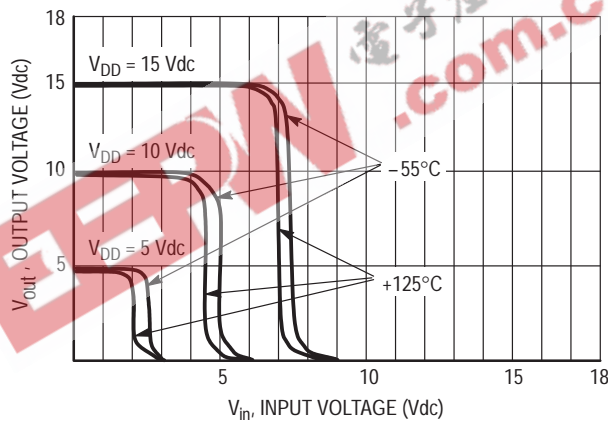


Figure 1. Typical Voltage Transfer Characteristics versus Temperature

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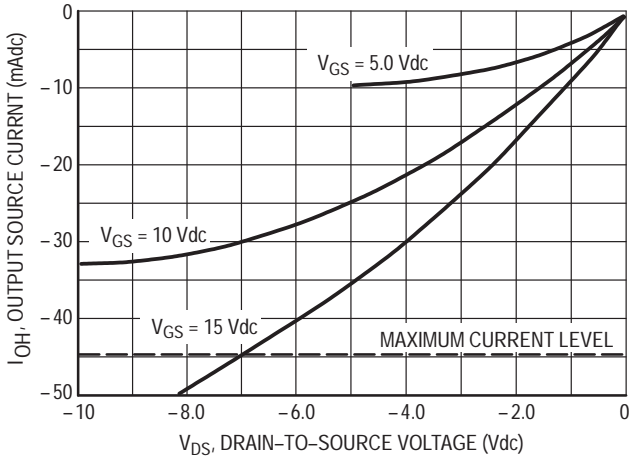
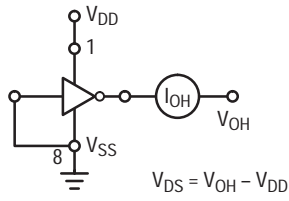


Figure 2. Typical Output Source Characteristics

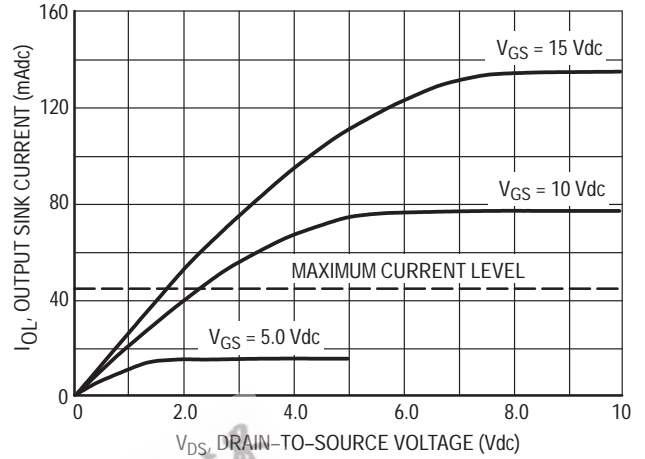
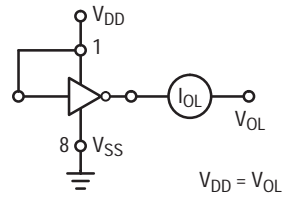


Figure 3. Typical Output Sink Characteristics

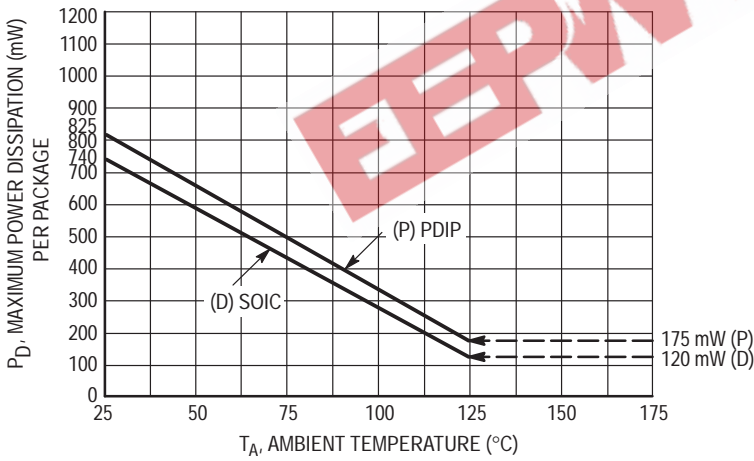


Figure 4. Ambient Temperature Power Derating

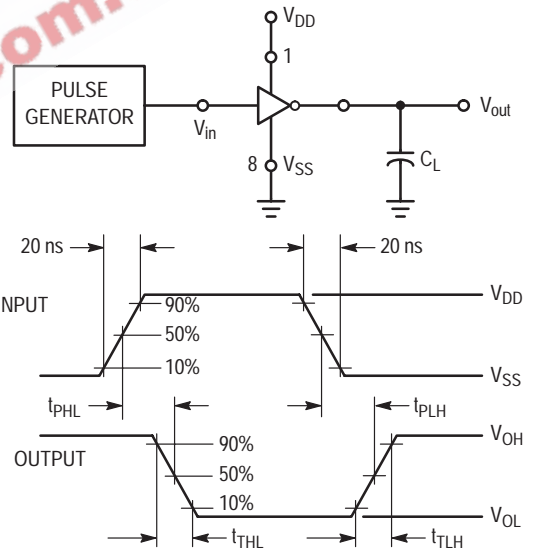
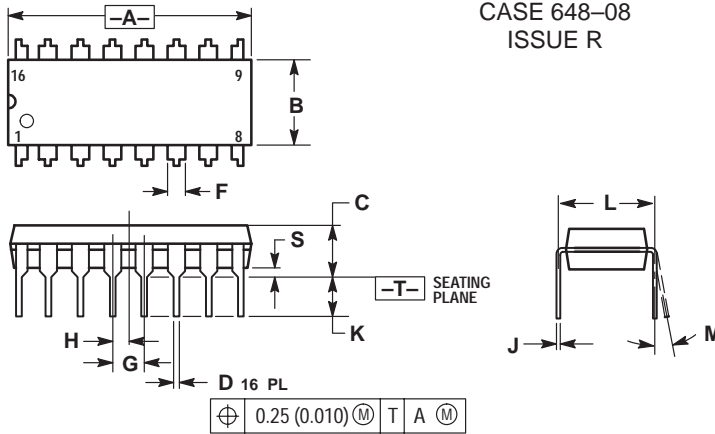


Figure 5. Switching Time Test Circuit and Waveforms

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PACKAGE DIMENSIONS

PDIP-16 P SUFFIX PLASTIC DIP PACKAGE CASE 648-08 ISSUE R

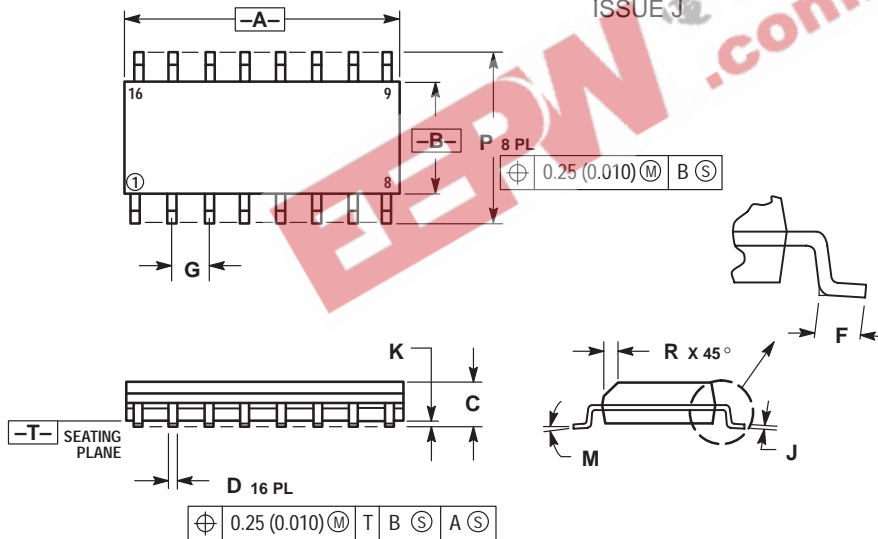


NOTES:

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 PLASTIC SOIC PACKAGE CASE 751B-05 ISSUE J



NOTES:

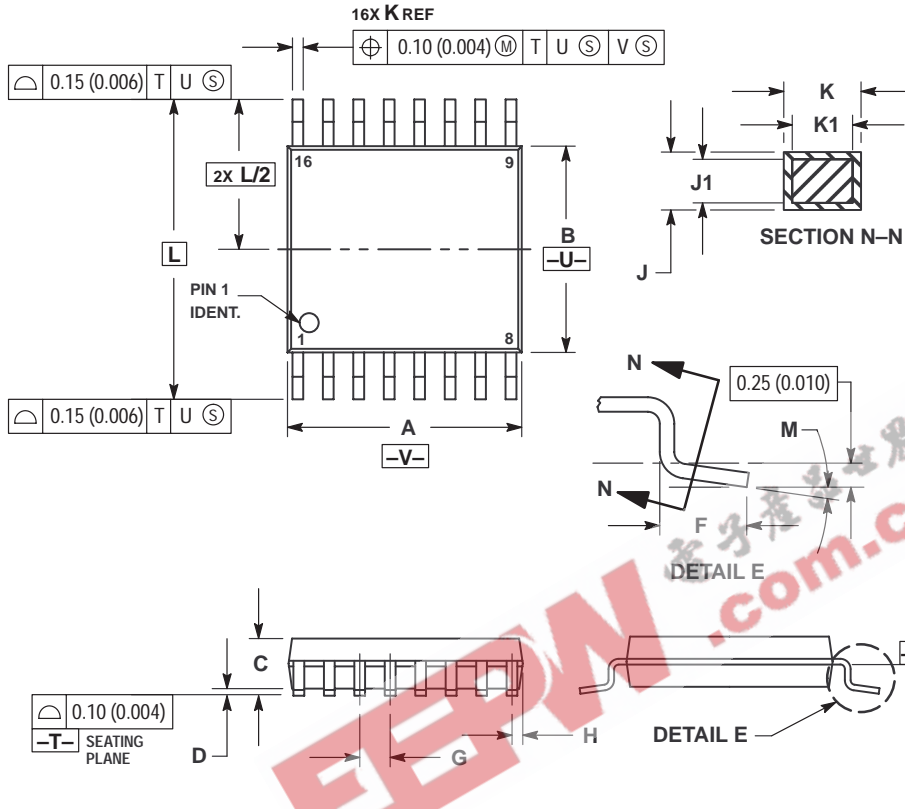
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL 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 |

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PACKAGE DIMENSIONS

TSSOP-16
DT SUFFIX
PLASTIC TSSOP PACKAGE
CASE 948F-01
ISSUE O



NOTES:

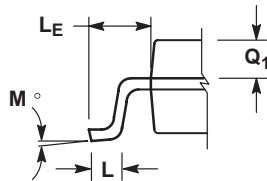
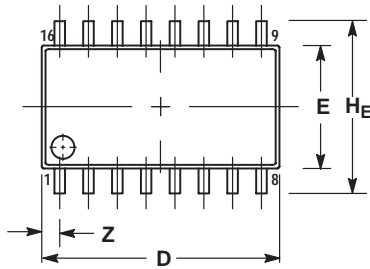
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD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

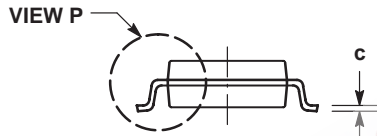
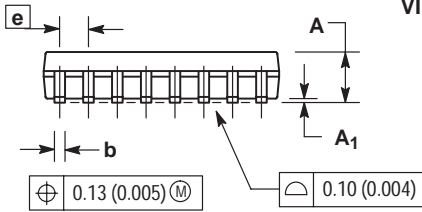
MC14049UB

PACKAGE DIMENSIONS

SOEIAJ-16
F SUFFIX
PLASTIC EIAJ SOIC PACKAGE
CASE 966-01
ISSUE O



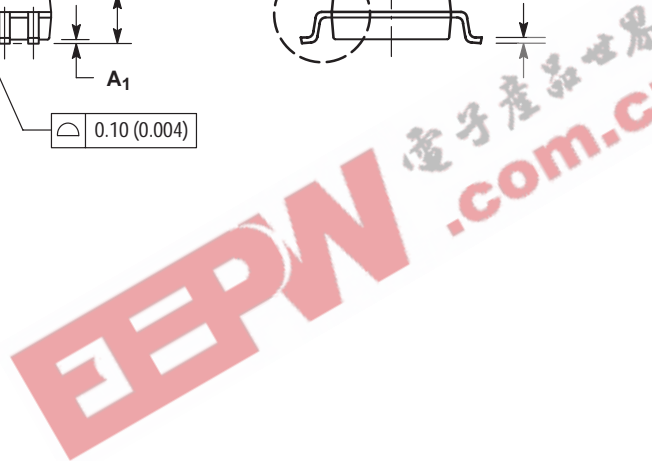
DETAIL P



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 ₁ | 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 | |
| H _E | 7.40 | 8.20 | 0.291 | 0.323 |
| L | 0.50 | 0.85 | 0.020 | 0.033 |
| L _E | 1.10 | 1.50 | 0.043 | 0.059 |
| M | 0° | 10° | 0° | 10° |
| Q ₁ | 0.70 | 0.90 | 0.028 | 0.035 |
| Z | --- | 0.78 | --- | 0.031 |



MC14049UB

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