

# MC74HCT04A

## Hex Inverter

### With LSTTL-Compatible Inputs High-Performance Silicon-Gate CMOS

The MC74HCT04A may be used as a level converter for interfacing TTL or NMOS outputs to High-Speed CMOS inputs. The HCT04A is identical in pinout to the LS04.

#### Features

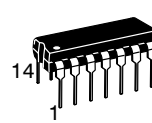
- Output Drive Capability: 10 LSTTL Loads
- TTL/NMOS-Compatible Input Levels
- Outputs Directly Interface to CMOS, NMOS and TTL
- Operating Voltage Range: 4.5 to 5.5 V
- Low Input Current: 1  $\mu$ A
- In Compliance With the JEDEC Standard No. 7 A Requirements
- Chip Complexity: 48 FETs or 12 Equivalent Gates
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant



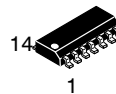
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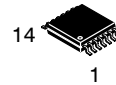
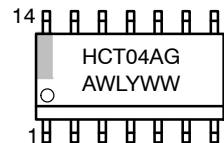
#### MARKING DIAGRAMS



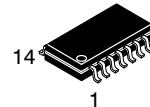
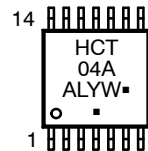
PDIP-14  
N SUFFIX  
CASE 646



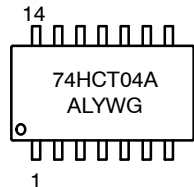
SOIC-14  
D SUFFIX  
CASE 751A



TSSOP-14  
DT SUFFIX  
CASE 948G



SOEIAJ-14  
F SUFFIX  
CASE 965



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

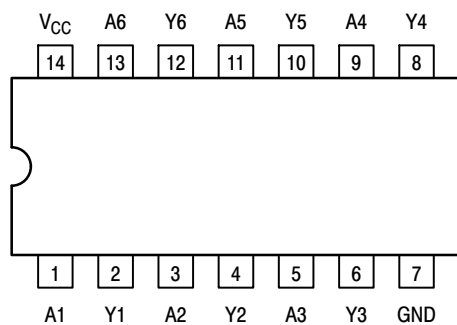
(Note: Microdot may be in either location)

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

# MC74HCT04A

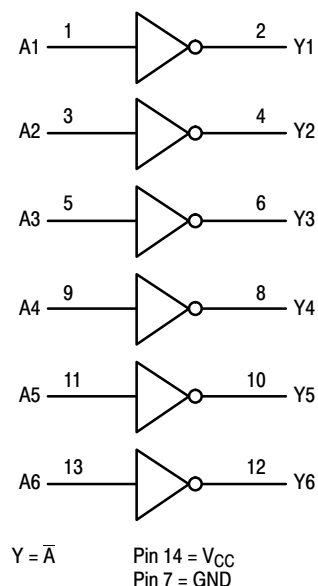
## Pinout: 14-Lead Packages (Top View)



## FUNCTION TABLE

| Inputs | Outputs |
|--------|---------|
| A      | Y       |
| L      | H       |
| H      | L       |

## LOGIC DIAGRAM



## ORDERING INFORMATION

| Device          | Package                | Shipping <sup>†</sup> |
|-----------------|------------------------|-----------------------|
| MC74HCT04ANG    | PDIP-14<br>(Pb-Free)   | 25 Units / Rail       |
| MC74HCT04ADG    | SOIC-14<br>(Pb-Free)   | 55 Units / Rail       |
| MC74HCT04ADR2G  | SOIC-14<br>(Pb-Free)   | 2500 / Tape & Reel    |
| MC74HCT04ADTR2G | TSSOP-14*              | 2500 / Tape & Reel    |
| MC74HCT04AFELG  | SOEIAJ-14<br>(Pb-Free) | 2000 / 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.

# MC74HCT04A

## 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  | Plastic DIP†<br>SOIC Package†<br>TSSOP Package† | 750<br>500<br>450 | mW |
| $T_{stg}$ | Storage Temperature Range   | - 65 to + 150                                   | °C                |    |
| $T_L$     | Lead Temperature, 1 mm from Case for 10 Seconds<br>Plastic DIP, SOIC or TSSOP Package | 260   | °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.

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

## 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 Range, All Package Types       | - 55 | + 125    | °C   |
| $t_r, t_f$        | Input Rise/Fall Time (Figure 1)                      | 0    | 500      | ns   |

## DC CHARACTERISTICS (Voltages Referenced to GND)

| Symbol          | Parameter                                      | Condition   | $V_{CC}$<br>V | Guaranteed Limit |             |        | Unit    |
|-----------------|--|---|---------------|------------------|-------------|--------|---------|
|                 |  |   |               | -55 to 25°C      | ≤85°C       | ≤125°C |         |
| $V_{IH}$        | Minimum High-Level Input Voltage               | $V_{out} = 0.1V$<br>$ I_{out}  \leq 20\mu A$  | 4.5           | 2.0              | 2.0         | 2.0    | V       |
|                 |  |   | 5.5           | 2.0              | 2.0         | 2.0    |         |
| $V_{IL}$        | Maximum Low-Level Input Voltage                | $V_{out} = V_{CC} - 0.1V$<br>$ I_{out}  \leq 20\mu A$   | 4.5           | 0.8              | 0.8         | 0.8    | V       |
|                 |  |   | 5.5           | 0.8              | 0.8         | 0.8    |         |
| $V_{OH}$        | Minimum High-Level Output Voltage              | $V_{in} = V_{IL}$<br>$ I_{out}  \leq 20\mu A$   | 4.5           | 4.4              | 4.4         | 4.4    | V       |
|                 |  |   | 5.5           | 5.4              | 5.4         | 5.4    |         |
| $V_{OL}$        | Maximum Low-Level Output Voltage               | $V_{in} = V_{IH}$<br>$ I_{out}  \leq 20\mu A$   | 4.5           | 0.1              | 0.1         | 0.1    | V       |
|                 |  |   | 5.5           | 0.1              | 0.1         | 0.1    |         |
| $I_{in}$        | Maximum Input Leakage Current                  | $V_{in} = V_{CC}$ or GND  | 4.5           | 0.26             | 0.33        | 0.40   | $\mu A$ |
|                 |  |   | 5.5           | 0.1              | 1.0         | 1.0    |         |
| $I_{CC}$        | Maximum Quiescent Supply Current (per Package) | $V_{in} = V_{CC}$ or GND<br>$I_{out} = 0\mu A$  | 4.5           | 1                | 10          | 40     | $\mu A$ |
|                 |  |   | 5.5           | 1                | 10          | 40     |         |
| $\Delta I_{CC}$ | Additional Quiescent Supply Current            | $V_{in} = 2.4V$ , Any One Input<br>$V_{in} = V_{CC}$ or GND, Other Inputs<br>$I_{out} = 0\mu A$ | 5.5           | ≥ -55°C          | 25 to 125°C |        | mA      |
|                 |  |   |               | 2.9              | 2.4         |        |         |

1. Total Supply Current =  $I_{CC} + \Sigma \Delta I_{CC}$ .

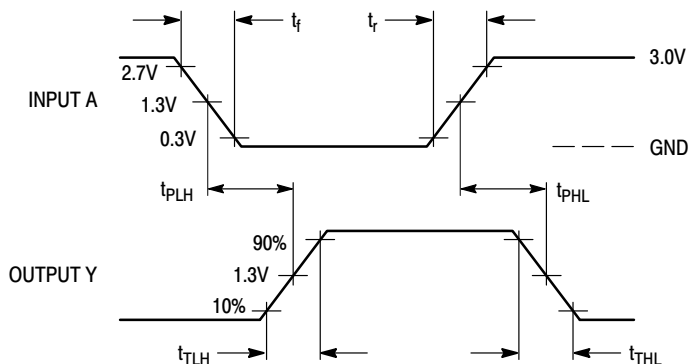
# MC74HCT04A

**AC CHARACTERISTICS** ( $V_{CC} = 5.0V \pm 10\%$ ,  $C_L = 50pF$ , Input  $t_r = t_f = 6ns$ )

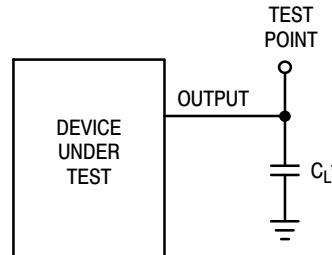
| Symbol                   | Parameter   | Guaranteed Limit |          |          | Unit |
|--------------------------|---|------------------|----------|----------|------|
|                          |   | -55 to 25°C      | ≤85°C    | ≤125°C   |      |
| $t_{PLH}$ ,<br>$t_{PHL}$ | Maximum Propagation Delay, Input A to Output Y<br>(Figures 1 and 2) | 15<br>17         | 19<br>21 | 22<br>26 | ns   |
| $t_{TLH}$ ,<br>$t_{THL}$ | Maximum Output Transition Time, Any Output<br>(Figures 1 and 2)     | 15               | 19       | 22       | ns   |
| $C_{in}$                 | Maximum Input Capacitance   | 10               | 10       | 10       | pF   |

| $C_{PD}$ | Power Dissipation Capacitance (Per Inverter)* | Typical @ 25°C, $V_{CC} = 5.0 V$ |  | pF |
|----------|---|----------------------------------|--|----|
|          |   | 22                               |  |    |

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

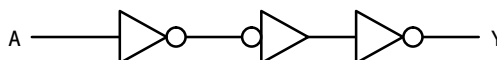


**Figure 1. Switching Waveforms**



\*Includes all probe and jig capacitance

**Figure 2. Test Circuit**

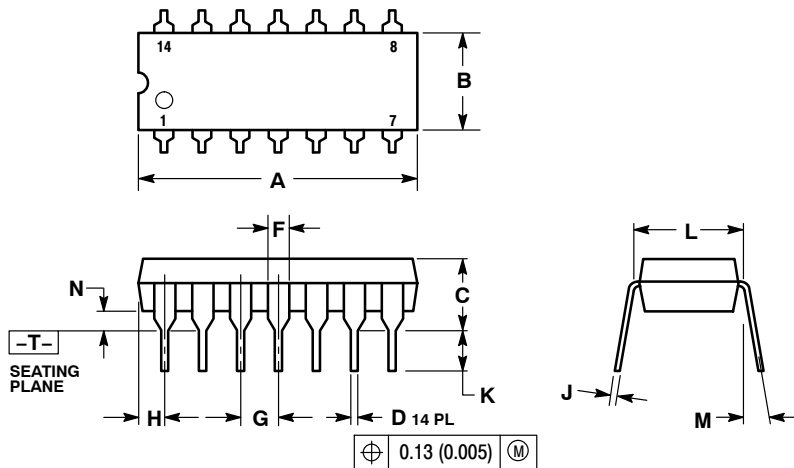


**Figure 3. Expanded Logic Diagram**  
(1/6 of the Device Shown)

# MC74HCT04A

## PACKAGE DIMENSIONS

PDIP-14  
N SUFFIX  
CASE 646-06  
ISSUE P



### NOTES:

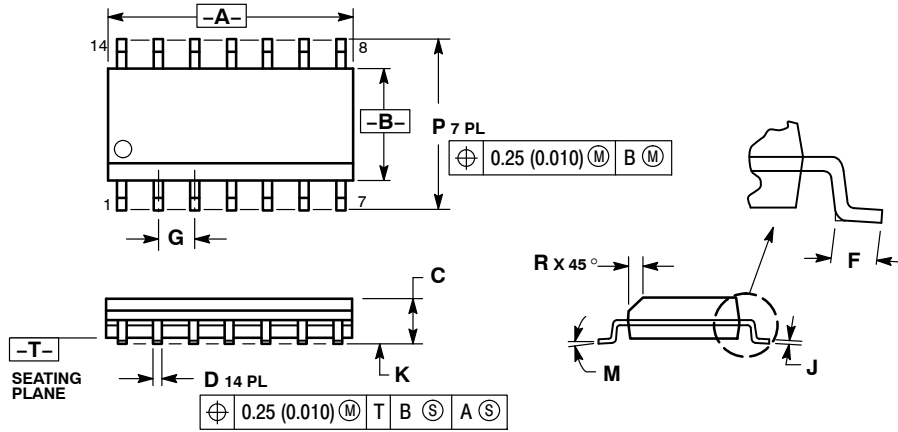
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.715     | 0.770 | 18.16       | 19.56 |
| B   | 0.240     | 0.260 | 6.10        | 6.60  |
| C   | 0.145     | 0.185 | 3.69        | 4.69  |
| D   | 0.015     | 0.021 | 0.38        | 0.53  |
| F   | 0.040     | 0.070 | 1.02        | 1.78  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.052     | 0.095 | 1.32        | 2.41  |
| J   | 0.008     | 0.015 | 0.20        | 0.38  |
| K   | 0.115     | 0.135 | 2.92        | 3.43  |
| L   | 0.290     | 0.310 | 7.37        | 7.87  |
| M   | ---       | 10°   | ---         | 10°   |
| N   | 0.015     | 0.039 | 0.38        | 1.01  |

# MC74HCT04A

## PACKAGE DIMENSIONS

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

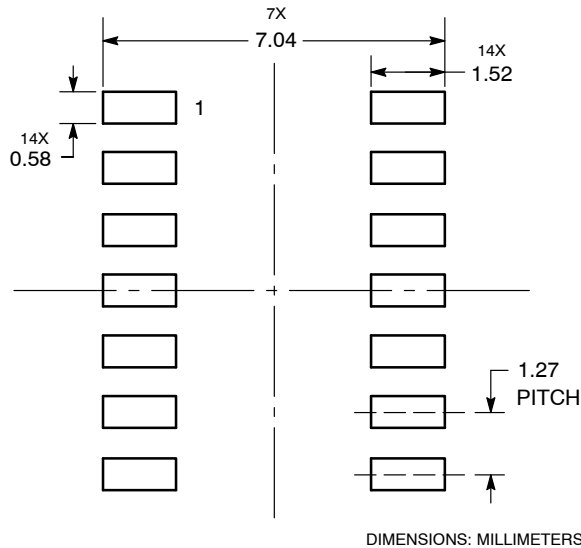


**NOTES:**

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

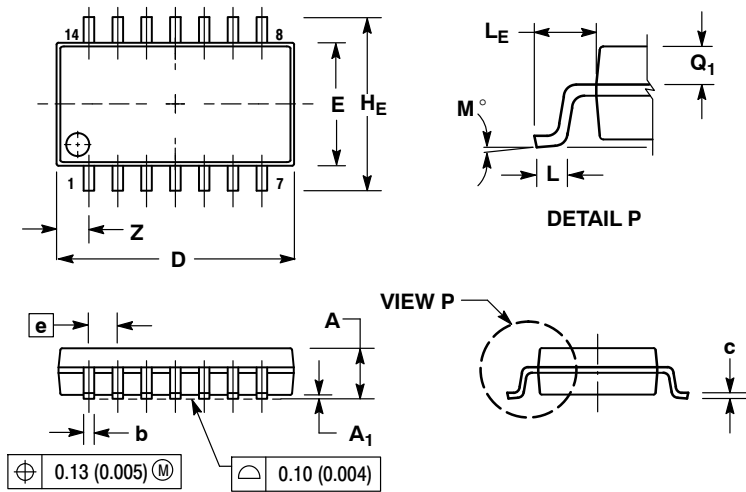




# MC74HCT04A

## PACKAGE DIMENSIONS

SOEIAJ-14  
F SUFFIX  
CASE 965-01  
ISSUE B



### 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              | 0.10        | 0.20  | 0.004     | 0.008 |
| 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 <sub>E</sub> | 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              | ---         | 1.42  | ---       | 0.056 |

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