

## MM74HCU04 Hex Inverter

### General Description

The MM74HCU04 inverters utilize advanced silicon-gate CMOS technology to achieve operating speeds similar to LS-TTL gates with the low power consumption of standard CMOS integrated circuits.

The MM74HCU04 is an unbuffered inverter. It has high noise immunity and the ability to drive 15 LS-TTL loads. The 74HCU logic family is functionally as well as pin-out compatible with the standard 74LS logic family. All inputs

are protected from damage due to static discharge by internal diode clamps to  $V_{CC}$  and ground.

### Features

- Typical propagation delay: 7 ns
- Fanout of 15 LS-TTL loads
- Quiescent power consumption: 10  $\mu$ A maximum at room temperature
- Low input current: 1  $\mu$ A maximum

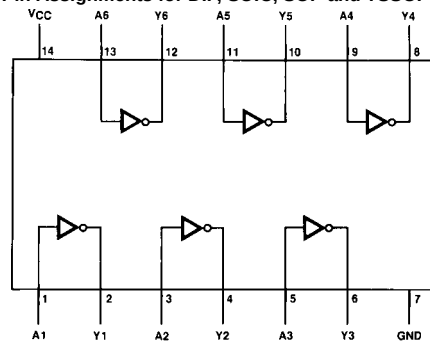
### Ordering Code:

| Order Number | Package Number | Package Description                                                          |
|--------------|----------------|------------------------------------------------------------------------------|
| MM74HCU04M   | M14A           | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow |
| MM74HCU04SJ  | M14D           | 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                |
| MM74HCU04MTC | MTC14          | 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  |
| MM74HCU04N   | N14A           | 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide       |

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

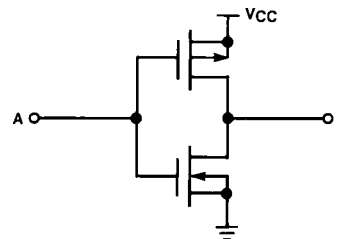
### Connection Diagram

Pin Assignments for DIP, SOIC, SOP and TSSOP



Top View

### Schematic Diagram



**Absolute Maximum Ratings** (Note 1)

(Note 2)

|                                                  |                         |
|--------------------------------------------------|-------------------------|
| Supply Voltage ( $V_{CC}$ )                      | –0.5 to +7.0V           |
| DC Input Voltage ( $V_{IN}$ )                    | –1.5 to $V_{CC} + 1.5V$ |
| DC Output Voltage ( $V_{OUT}$ )                  | –0.5 to $V_{CC} + 0.5V$ |
| Clamp Diode Current ( $I_{IK}, I_{OK}$ )         | ±20 mA                  |
| DC Output Current, per pin ( $I_{OUT}$ )         | ±25 mA                  |
| DC $V_{CC}$ or GND Current, per pin ( $I_{CC}$ ) | ±50 mA                  |
| Storage Temperature Range ( $T_{STG}$ )          | –65°C to +150°C         |
| Power Dissipation ( $P_D$ )                      |                         |
| (Note 3)                                         | 600 mW                  |
| S.O. Package only                                | 500 mW                  |
| Lead Temperature ( $T_L$ )                       |                         |
| (Soldering 10 seconds)                           | 260°C                   |

**Recommended Operating Conditions**

|                                                     | Min | Max      | Units |
|-----------------------------------------------------|-----|----------|-------|
| Supply Voltage ( $V_{CC}$ )                         | 2   | 6        | V     |
| DC Input or Output Voltage<br>( $V_{IN}, V_{OUT}$ ) | 0   | $V_{CC}$ | V     |
| Operating Temperature Range ( $T_A$ )               | –40 | +85      | °C    |

**Note 1:** Absolute Maximum Ratings are those values beyond which damage to the device may occur.

**Note 2:** Unless otherwise specified all voltages are referenced to ground.

**Note 3:** Power Dissipation temperature derating — plastic "N" package: –12 mW/°C from 65°C to 85°C.

**DC Electrical Characteristics** (Note 4)

| Symbol          | Parameter                         | Conditions                                                                                        | V <sub>CC</sub> | T <sub>A</sub> = 25°C |                   | T <sub>A</sub> = −40 to 85°C | T <sub>A</sub> = −55 to 125°C | Units |
|-----------------|-----------------------------------|---------------------------------------------------------------------------------------------------|-----------------|-----------------------|-------------------|------------------------------|-------------------------------|-------|
|                 |                                   |                                                                                                   |                 | Typ                   | Guaranteed Limits |                              |                               |       |
| V <sub>IH</sub> | Minimum HIGH Level Input Voltage  |                                                                                                   | 2.0V            |                       | 1.7               | 1.7                          | 1.7                           | V     |
|                 |                                   |                                                                                                   | 4.5V            |                       | 3.6               | 3.6                          | 3.6                           | V     |
|                 |                                   |                                                                                                   | 6.0V            |                       | 4.8               | 4.8                          | 4.8                           | V     |
| V <sub>IL</sub> | Maximum LOW Level Input Voltage   |                                                                                                   | 2.0V            |                       | 0.3               | 0.3                          | 0.3                           | V     |
|                 |                                   |                                                                                                   | 4.5V            |                       | 0.8               | 0.8                          | 0.8                           | V     |
|                 |                                   |                                                                                                   | 6.0V            |                       | 1.1               | 1.1                          | 1.1                           | V     |
| V <sub>OH</sub> | Minimum HIGH Level Output Voltage | V <sub>IN</sub> = V <sub>IL</sub><br> I <sub>OUT</sub>   ≤ 20 μA                                  | 2.0V            | 2.0                   | 1.8               | 1.8                          | 1.8                           | V     |
|                 |                                   |                                                                                                   | 4.5V            | 4.5                   | 4.0               | 4.0                          | 4.0                           | V     |
|                 |                                   |                                                                                                   | 6.0V            | 6.0                   | 5.5               | 5.5                          | 5.5                           | V     |
|                 |                                   | V <sub>IN</sub> = GND<br> I <sub>OUT</sub>   ≤ 4.0 mA<br> I <sub>OUT</sub>   ≤ 5.2 mA             | 4.5V            | 4.2                   | 3.98              | 3.84                         | 3.7                           | V     |
|                 |                                   |                                                                                                   | 6.0V            | 5.7                   | 5.48              | 5.34                         | 5.2                           | V     |
|                 |                                   |                                                                                                   |                 |                       |                   |                              |                               |       |
| V <sub>OL</sub> | Maximum LOW Level Output Voltage  | V <sub>IN</sub> = V <sub>IH</sub><br> I <sub>OUT</sub>   ≤ 20 μA                                  | 2.0V            | 0                     | 0.2               | 0.2                          | 0.2                           | V     |
|                 |                                   |                                                                                                   | 4.5V            | 0                     | 0.5               | 0.5                          | 0.5                           | V     |
|                 |                                   |                                                                                                   | 6.0V            | 0                     | 0.5               | 0.5                          | 0.5                           | V     |
|                 |                                   | V <sub>IN</sub> = V <sub>CC</sub><br> I <sub>OUT</sub>   ≤ 6.0 mA<br> I <sub>OUT</sub>   ≤ 7.8 mA | 4.5V            | 0.2                   | 0.26              | 0.33                         | 0.4                           | V     |
|                 |                                   |                                                                                                   | 6.0V            | 0.2                   | 0.26              | 0.33                         | 0.4                           | V     |
|                 |                                   |                                                                                                   |                 |                       |                   |                              |                               |       |
| I <sub>IN</sub> | Maximum Input Current             | V <sub>IN</sub> = V <sub>CC</sub> or GND                                                          | 6.0V            |                       | ±0.1              | ±1.0                         | ±1.0                          | μA    |
| I <sub>CC</sub> | Maximum Quiescent Supply Current  | V <sub>IN</sub> = V <sub>CC</sub> or GND<br>I <sub>OUT</sub> = 0 μA                               | 6.0V            |                       | 2.0               | 20                           | 40                            | μA    |

**Note 4:** For a power supply of 5V ±10% the worst case output voltages ( $V_{OH}$  and  $V_{OL}$ ) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case  $V_{IH}$  and  $V_{IL}$  occur at  $V_{CC} = 5.5V$  and 4.5V respectively. (The  $V_{IH}$  value at 5.5V is 3.85V.) The worst case leakage current ( $I_{IN}$ ,  $I_{CC}$ , and  $I_{OZ}$ ) occur for CMOS at the higher voltage and so the 6.0V values should be used.

## AC Electrical Characteristics

$V_{CC} = 5V$ ,  $T_A = 25^\circ C$ ,  $C_L = 15\text{ pF}$ ,  $t_r = t_f = 6\text{ ns}$

| Symbol                | Parameter                 | Conditions | Typ | Guaranteed Limit | Units |
|-----------------------|---------------------------|------------|-----|------------------|-------|
| $t_{PHL}$ , $t_{PLH}$ | Maximum Propagation Delay |            | 7   | 13               | ns    |

## AC Electrical Characteristics

$V_{CC} = 2.0V$  to  $6.0V$ ,  $C_L = 50\text{ pF}$ ,  $t_r = t_f = 6\text{ ns}$  (unless otherwise specified)

| Symbol                              | Parameter                              | Conditions | V <sub>CC</sub> | T <sub>A</sub> =25°C |                   | T <sub>A</sub> =−40 to 85°C | T <sub>A</sub> =−55 to 125°C | Units |
|-------------------------------------|----------------------------------------|------------|-----------------|----------------------|-------------------|-----------------------------|------------------------------|-------|
|                                     |                                        |            |                 | Typ                  | Guaranteed Limits |                             |                              |       |
| t <sub>PHL</sub> , t <sub>PLH</sub> | Maximum Propagation Delay              |            | 2.0V            | 49                   | 82                | 103                         | 120                          | ns    |
|                                     |                                        |            | 4.5V            | 9.9                  | 16                | 21                          | 24                           | ns    |
|                                     |                                        |            | 6.0V            | 8.4                  | 14                | 18                          | 20                           | ns    |
| t <sub>TLH</sub> , t <sub>THL</sub> | Maximum Output Rise and Fall Time      |            | 2.0V            | 30                   | 75                | 95                          | 110                          | ns    |
|                                     |                                        |            | 4.5V            | 8                    | 15                | 19                          | 22                           | ns    |
|                                     |                                        |            | 6.0V            | 7                    | 13                | 16                          | 19                           | ns    |
| C <sub>PD</sub>                     | Power Dissipation Capacitance (Note 5) | (per gate) |                 | 90                   |                   |                             |                              | pF    |
| C <sub>IN</sub>                     | Maximum Input Capacitance              |            |                 | 8                    | 15                | 15                          | 15                           | pF    |

**Note 5:**  $C_{PD}$  determines the no load dynamic power consumption,  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ , and the no load dynamic current consumption,  $I_S = C_{PD} V_{CC} f + I_{CC}$ .

## Typical Applications

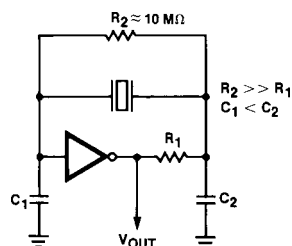


FIGURE 1. Crystal Oscillator

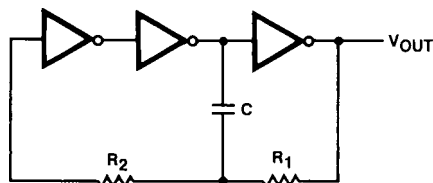


FIGURE 2. Stable RC Oscillator

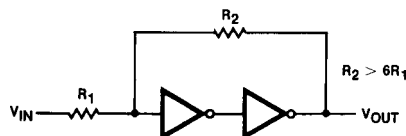
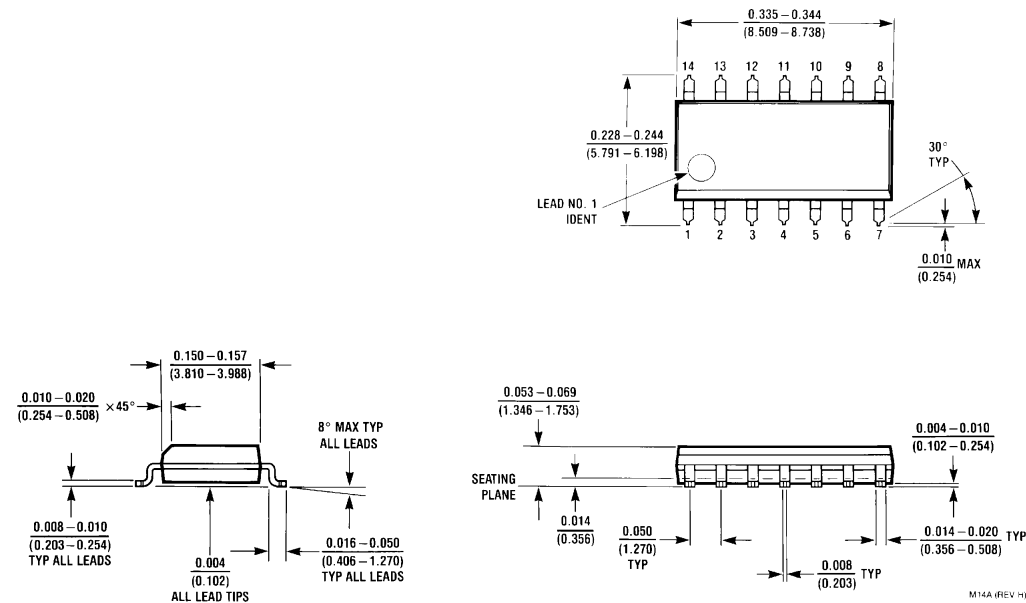
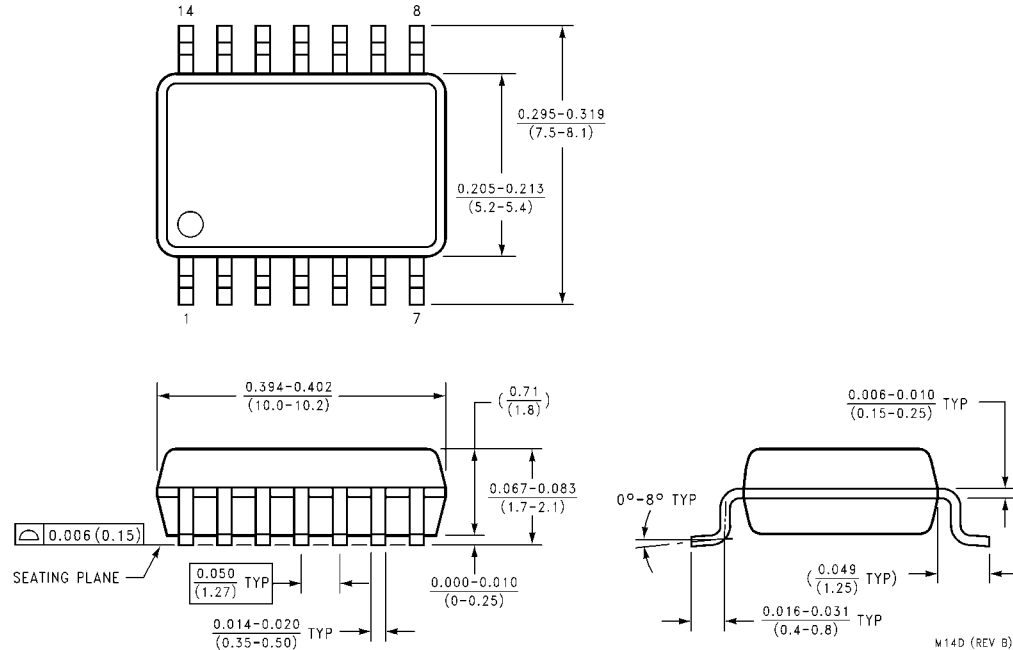


FIGURE 3. Schmitt Trigger

# Physical Dimensions inches (millimeters) unless otherwise noted



**14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow Package Number M14A**



**14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide Package Number M14D**

5.0 ± 0.1  
-A-

0.43 TYP

14

8

6.4

3.2

4.4 ± 0.1  
-B-

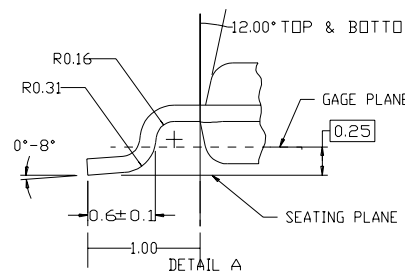
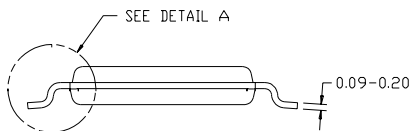
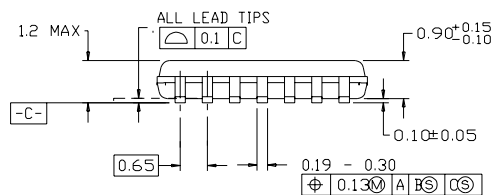
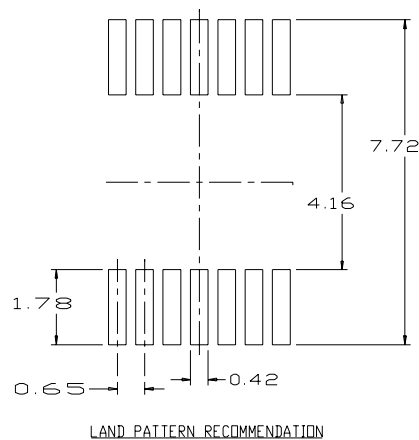
PIN #1 IDENT.

1

7

|  |     |   |   |   |
|--|-----|---|---|---|
|  | 0.2 | C | B | A |
|--|-----|---|---|---|

ALL LEAD TIPS

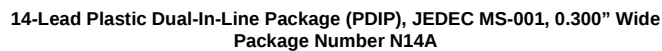


A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB,  
REF NOTE 6, DATED 7/93

B. DIMENSIONS ARE IN MILLIMETERS

C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH,  
AND TIE BAR EXTRUSIONS

5



FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

- www.fairchildsemi.com