



ON Semiconductor®

# MM74HC04

## Hex Inverter

### Features

- Typical propagation delay: 8ns
- Fan out of 10 LS-TTL loads
- Quiescent power consumption: 10μW maximum at room temperature
- Low input current: 1μA maximum

### General Description

The MM74HC04 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 MM74HC04 is a triple buffered inverter. It has high noise immunity and the ability to drive 10 LS-TTL loads. The 74HC 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.

### Ordering Information

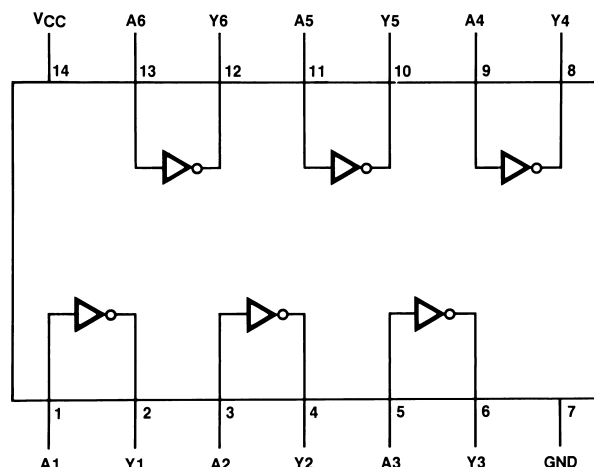
| Order Number | Package Number | Package Description                                                          |
|--------------|----------------|------------------------------------------------------------------------------|
| MM74HC04M    | M14A           | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| MM74HC04SJ   | M14D           | 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                |
| MM74HC04MTC  | MTC14          | 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  |
| MM74HC04N    | N14A           | 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide       |

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

 All packages are lead free per JEDEC: J-STD-020B standard.

### Connection Diagram

Pin Assignments for DIP, SOIC, SOP and TSSOP



Top View

### Logic Diagram

1 of 6 Inverters



## Absolute Maximum Ratings<sup>(1)</sup>

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol           | Parameter                               | Rating                |
|------------------|-----------------------------------------|-----------------------|
| $V_{CC}$         | Supply Voltage                          | −0.5 to +7.0V         |
| $V_{IN}$         | DC Input Voltage                        | −1.5 to $V_{CC}+1.5V$ |
| $V_{OUT}$        | DC Output Voltage                       | −0.5 to $V_{CC}+0.5V$ |
| $I_{IK}, I_{OK}$ | Clamp Diode Current                     | ±20mA                 |
| $I_{OUT}$        | DC Output Current, per pin              | ±25mA                 |
| $I_{CC}$         | DC $V_{CC}$ or GND Current, per pin     | ±50mA                 |
| $T_{STG}$        | Storage Temperature Range               | −65°C to +150°C       |
| $P_D$            | Power Dissipation<br>Note 2             | 600mW                 |
|                  | S.O. Package only                       | 500mW                 |
| $T_L$            | Lead Temperature (Soldering 10 seconds) | 260°C                 |

### Notes:

1. Unless otherwise specified all voltages are referenced to ground.
2. Power Dissipation temperature derating — plastic “N” package: −12mW/°C from 65°C to 85°C.

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the data sheet specifications. ON Semiconductor does not recommend exceeding them or designing to absolute maximum ratings.

| Symbol            | Parameter                                   | Min. | Max.     | Units |
|-------------------|---------------------------------------------|------|----------|-------|
| $V_{CC}$          | Supply Voltage                              | 2    | 6        | V     |
| $V_{IN}, V_{OUT}$ | DC Input or Output Voltage                  | 0    | $V_{CC}$ | V     |
| $T_A$             | Operating Temperature Range                 | −40  | +85      | °C    |
| $t_r, t_f$        | Input Rise or Fall Times<br>$V_{CC} = 2.0V$ |      | 1000     | ns    |
|                   | $V_{CC} = 4.5V$                             |      | 500      | ns    |
|                   | $V_{CC} = 6.0V$                             |      | 400      | ns    |

DC Electrical Characteristics<sup>(3)</sup>

| Symbol          | Parameter                         | V <sub>CC</sub> (V) | Conditions                                                          | T <sub>A</sub> = 25°C |                   | T <sub>A</sub> = −40°C<br>to 85°C | T <sub>A</sub> = −55°C<br>to 125°C | Units |
|-----------------|-----------------------------------|---------------------|---------------------------------------------------------------------|-----------------------|-------------------|-----------------------------------|------------------------------------|-------|
|                 |                                   |                     |                                                                     | Typ.                  | Guaranteed Limits |                                   |                                    |       |
| V <sub>IH</sub> | Minimum HIGH Level Input Voltage  | 2.0                 |                                                                     |                       | 1.5               | 1.5                               | 1.5                                | V     |
|                 |                                   | 4.5                 |                                                                     |                       | 3.15              | 3.15                              | 3.15                               |       |
|                 |                                   | 6.0                 |                                                                     |                       | 4.2               | 4.2                               | 4.2                                |       |
| V <sub>IL</sub> | Maximum LOW Level Input Voltage   | 2.0                 |                                                                     |                       | 0.5               | 0.5                               | 0.5                                | V     |
|                 |                                   | 4.5                 |                                                                     |                       | 1.35              | 1.35                              | 1.35                               |       |
|                 |                                   | 6.0                 |                                                                     |                       | 1.8               | 1.8                               | 1.8                                |       |
| V <sub>OH</sub> | Minimum HIGH Level Output Voltage | 2.0                 | V <sub>IN</sub> = V <sub>IL</sub> ,<br> I <sub>OUT</sub>   ≤ 20μA   | 2.0                   | 1.9               | 1.9                               | 1.9                                | V     |
|                 |                                   | 4.5                 |                                                                     | 4.5                   | 4.4               | 4.4                               | 4.4                                |       |
|                 |                                   | 6.0                 |                                                                     | 6.0                   | 5.9               | 5.9                               | 5.9                                |       |
|                 |                                   | 4.5                 | V <sub>IN</sub> = V <sub>IL</sub> ,<br> I <sub>OUT</sub>   ≤ 4.0mA  | 4.2                   | 3.98              | 3.84                              | 3.7                                |       |
|                 |                                   | 6.0                 | V <sub>IN</sub> = V <sub>IL</sub> ,<br> I <sub>OUT</sub>   ≤ 5.2mA  | 5.7                   | 5.48              | 5.34                              | 5.2                                |       |
| V <sub>OL</sub> | Maximum LOW Level Output Voltage  | 2.0                 | V <sub>IN</sub> = V <sub>IH</sub> ,<br> I <sub>OUT</sub>   ≤ 20μA   | 0                     | 0.1               | 0.1                               | 0.1                                | V     |
|                 |                                   | 4.5                 |                                                                     | 0                     | 0.1               | 0.1                               | 0.1                                |       |
|                 |                                   | 6.0                 |                                                                     | 0                     | 0.1               | 0.1                               | 0.1                                |       |
|                 |                                   | 4.5                 | V <sub>IN</sub> = V <sub>IH</sub> ,<br> I <sub>OUT</sub>   ≤ 4.0mA  | 0.2                   | 0.26              | 0.33                              | 0.4                                |       |
|                 |                                   | 6.0                 | V <sub>IN</sub> = V <sub>IH</sub> ,<br> I <sub>OUT</sub>   ≤ 5.2mA  | 0.2                   | 0.26              | 0.33                              | 0.4                                |       |
| I <sub>IN</sub> | Maximum Input Current             | 6.0                 | V <sub>IN</sub> = V <sub>CC</sub> or GND                            |                       | ±0.1              | ±1.0                              | ±1.0                               | μA    |
| I <sub>CC</sub> | Maximum Quiescent Supply Current  | 6.0                 | V <sub>IN</sub> = V <sub>CC</sub> or GND,<br>I <sub>OUT</sub> = 0μA |                       | 2.0               | 20                                | 40                                 | μA    |

**Note:**

3. For a power supply of 5V ±10% the worst case output voltages (V<sub>OH</sub>, and V<sub>OL</sub>) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case V<sub>IH</sub> and V<sub>IL</sub> occur at V<sub>CC</sub> = 5.5V and 4.5V respectively. (The V<sub>IH</sub> value at 5.5V is 3.85V.) The worst case leakage current (I<sub>IN</sub>, I<sub>CC</sub>, and I<sub>OZ</sub>) occur for CMOS at the higher voltage and so the 6.0V values should be used.

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

| Symbol                | Parameter                 | Conditions | Typ. | Guaranteed Limit | Units |
|-----------------------|---------------------------|------------|------|------------------|-------|
| $t_{PHL}$ , $t_{PLH}$ | Maximum Propagation Delay |            | 8    | 15               | ns    |

**AC Electrical Characteristics**
 $V_{CC} = 2.0V$  to  $6.0V$ ,  $C_L = 50pF$ ,  $t_r = t_f = 6ns$  (unless otherwise specified)

| Symbol                              | Parameter                                    | V <sub>CC</sub> (V) | Conditions | T <sub>A</sub> = 25°C |                   | T <sub>A</sub> = −40°C<br>to 85°C | T <sub>A</sub> = −55°C<br>to 125°C | Units |
|-------------------------------------|----------------------------------------------|---------------------|------------|-----------------------|-------------------|-----------------------------------|------------------------------------|-------|
|                                     |                                              |                     |            | Typ.                  | Guaranteed Limits |                                   |                                    |       |
| t <sub>PHL</sub> , t <sub>PLH</sub> | Maximum Propagation Delay                    | 2.0                 |            | 55                    | 95                | 120                               | 145                                | ns    |
|                                     |                                              | 4.5                 |            | 11                    | 19                | 24                                | 29                                 |       |
|                                     |                                              | 6.0                 |            | 9                     | 16                | 20                                | 24                                 |       |
| t <sub>TLH</sub> , t <sub>THL</sub> | Maximum Output Rise and Fall Time            | 2.0                 |            | 30                    | 75                | 95                                | 110                                | ns    |
|                                     |                                              | 4.5                 |            | 8                     | 15                | 19                                | 22                                 |       |
|                                     |                                              | 6.0                 |            | 7                     | 13                | 16                                | 19                                 |       |
| C <sub>PD</sub>                     | Power Dissipation Capacitance <sup>(4)</sup> |                     | (per gate) | 20                    |                   |                                   |                                    | pF    |
| C <sub>IN</sub>                     | Maximum Input Capacitance                    |                     |            | 5                     | 10                | 10                                | 10                                 | pF    |

**Note:**

4.  $C_{PD}$  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,  $I_S = C_{PD} V_{CC} f + I_{CC}$ .

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