

# Hex Inverter

## MM74HC04

### 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.

### Features

- Typical Propagation Delay: 8 ns
- Fan Out of 10 LS-TTL Loads
- Quiescent Power Consumption: 10  $\mu$ W Maximum at Room Temperature
- Low Input Current: 1  $\mu$ A Maximum
- These Devices are Pb-Free, Halide Free and are RoHS Compliant

### Connection Diagram

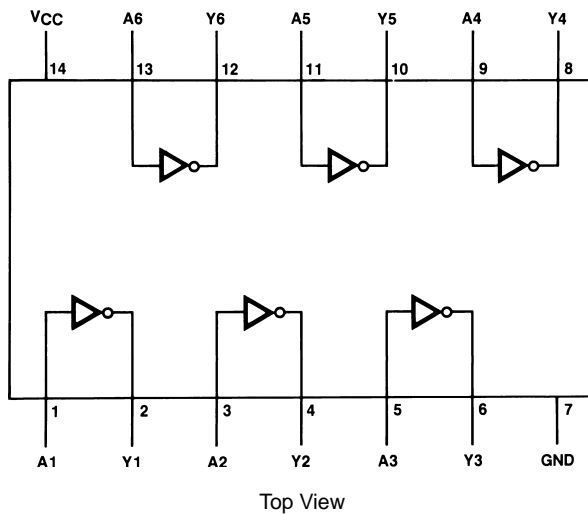


Figure 1. Pin Assignments for SOIC and TSSOP

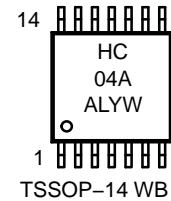
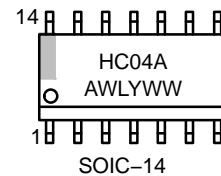
### Logic Diagram



Figure 2. 1 of 6 Inverters



### MARKING DIAGRAM



HC04A = Specific Device Code  
A = Assembly Location  
WL, L = Wafer Lot  
Y = Year  
WW, W = Work Week

### ORDERING INFORMATION

See detailed ordering and shipping information on page 4 of this data sheet.

# MM74HC04

## ABSOLUTE MAXIMUM RATINGS (Note 1)

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

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

## RECOMMENDED OPERATING CONDITIONS

| Symbol            | Parameter                   |                  | Min | Max      | Unit |
|-------------------|-----------------------------|------------------|-----|----------|------|
| $V_{CC}$          | Supply Voltage              |                  | 2   | 6        | V    |
| $V_{IN}, V_{OUT}$ | DC Input or Output Voltage  |                  | 0   | $V_{CC}$ | V    |
| $T_A$             | Operating Temperature Range |                  | -55 | +125     | °C   |
| $t_r, t_f$        | Input Rise or Fall Times    | $V_{CC} = 2.0$ V | -   | 1000     | ns   |
|                   |                             | $V_{CC} = 4.5$ V | -   | 500      | ns   |
|                   |                             | $V_{CC} = 6.0$ V | -   | 400      | ns   |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

# MM74HC04

## DC CHARACTERISTICS (Note 3)

| Symbol          | Parameter                         | V <sub>CC</sub><br>(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 | Unit |
|-----------------|-----------------------------------|------------------------|--|--|-------------------|-----------------------------------|------------------------------------|------|
|                 |                                   |                        |  | 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>IH</sub> or V <sub>IL</sub> ,<br> I <sub>OUT</sub>   ≤ 20 μA  | 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>IH</sub> or V <sub>IL</sub> ,<br> I <sub>OUT</sub>   ≤ 4.0 mA | 4.2  | 3.98              | 3.84                              | 3.7                                |      |
|                 |                                   | 6.0                    |  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> ,<br> I <sub>OUT</sub>   ≤ 5.2 mA | 5.7               | 5.48                              | 5.34                               |      |
| V <sub>OL</sub> | Maximum LOW Level Output Voltage  | 2.0                    | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> ,<br> I <sub>OUT</sub>   ≤ 20 μA  | 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> or V <sub>IL</sub> ,<br> I <sub>OUT</sub>   ≤ 4.0 mA | 0.2  | 0.26              | 0.33                              | 0.4                                |      |
|                 |                                   | 6.0                    |  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> ,<br> I <sub>OUT</sub>   ≤ 5.2 mA | 0.2               | 0.26                              | 0.33                               |      |
| 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<br>GND, I <sub>OUT</sub> = 0 μA                   | -  | 2.0               | 20                                | 40                                 | μA   |

3. For a power supply of 5 V ±10% the worst case output voltages (V<sub>OH</sub>, and V<sub>OL</sub>) occur for HC at 4.5 V. Thus the 4.5 V 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> = 5.5 V and 4.5 V respectively. (The V<sub>IH</sub> value at 5.5 V is 3.85 V.) 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 6.0 V values should be used.

## AC CHARACTERISTICS (V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C, C<sub>L</sub> = 15 pF, t<sub>r</sub> = t<sub>f</sub> = 6 ns)

| Symbol                              | Parameter                 | Conditions | Typ | Guaranteed Limit | Unit |
|-------------------------------------|---------------------------|------------|-----|------------------|------|
| t <sub>PHL</sub> , t <sub>PLH</sub> | Maximum Propagation Delay |            | 8   | 15               | ns   |

## AC CHARACTERISTICS (V<sub>CC</sub> = 2.0 V to 6.0 V, C<sub>L</sub> = 50 pF, t<sub>r</sub> = t<sub>f</sub> = 6 ns (unless otherwise specified))

| Symbol                              | Parameter                              | V <sub>CC</sub><br>(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 | Unit |
|-------------------------------------|--|------------------------|------------|-----------------------|-------------------|-----------------------------------|------------------------------------|------|
|                                     |  |                        |            | 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 (Note 4) |                        | (per gate) | 20                    | -                 | -                                 | -                                  | pF   |
| C <sub>IN</sub>                     | Maximum Input Capacitance              |                        |            | 5                     | 10                | 10                                | 10                                 | pF   |

4. C<sub>PD</sub> determines the no load dynamic power consumption, P<sub>D</sub> = C<sub>PD</sub> V<sub>CC</sub><sup>2</sup> f + I<sub>CC</sub> V<sub>CC</sub>, and the no load dynamic current consumption, I<sub>S</sub> = C<sub>PD</sub> V<sub>CC</sub> f + I<sub>CC</sub>.

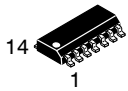
# MM74HC04

## ORDERING INFORMATION

| Part Number  | Package  | Shipping†                |
|--------------|--|--------------------------|
| MM74HC04M    | SOIC-14, Case 751A-03<br>(Pb-Free, Halide-Free)  | 55 Units / Tube          |
| MM74HC04MTC  | TSSOP-14, Case 948G-01<br>(Pb-Free, Halide Free) | 96 Units / Tube          |
| MM74HC04MX   | SOIC-14, Case 751EF<br>(Pb-Free, Halide-Free)    | 2500 Units / Tape & Reel |
| MM74HC04MTCX | TSSOP-14, Case 948G-01<br>(Pb-Free, Halide Free) | 2500 Units / Tape & Reel |

†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.

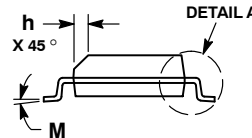
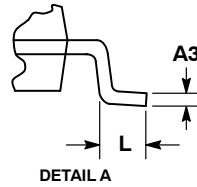
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 1:1

SOIC-14 NB  
CASE 751A-03  
ISSUE L

DATE 03 FEB 2016



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 1.35        | 1.75 | 0.054     | 0.068 |
| A1  | 0.10        | 0.25 | 0.004     | 0.010 |
| A3  | 0.19        | 0.25 | 0.008     | 0.010 |
| b   | 0.35        | 0.49 | 0.014     | 0.019 |
| D   | 8.55        | 8.75 | 0.337     | 0.344 |
| E   | 3.80        | 4.00 | 0.150     | 0.157 |
| e   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 5.80        | 6.20 | 0.228     | 0.244 |
| h   | 0.25        | 0.50 | 0.010     | 0.019 |
| L   | 0.40        | 1.25 | 0.016     | 0.049 |
| M   | 0°          | 7°   | 0°        | 7°    |

SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC MARKING DIAGRAM\*



- XXXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- Y = Year
- WW = Work Week
- G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

|                  |             |  |
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**SOIC-14**  
**CASE 751A-03**  
**ISSUE L**

DATE 03 FEB 2016

STYLE 1:  
 PIN 1. COMMON CATHODE  
 2. ANODE/CATHODE  
 3. ANODE/CATHODE  
 4. NO CONNECTION  
 5. ANODE/CATHODE  
 6. NO CONNECTION  
 7. ANODE/CATHODE  
 8. ANODE/CATHODE  
 9. ANODE/CATHODE  
 10. NO CONNECTION  
 11. ANODE/CATHODE  
 12. ANODE/CATHODE  
 13. NO CONNECTION  
 14. COMMON ANODE

STYLE 2:  
 CANCELLED

STYLE 3:  
 PIN 1. NO CONNECTION  
 2. ANODE  
 3. ANODE  
 4. NO CONNECTION  
 5. ANODE  
 6. NO CONNECTION  
 7. ANODE  
 8. ANODE  
 9. ANODE  
 10. NO CONNECTION  
 11. ANODE  
 12. ANODE  
 13. NO CONNECTION  
 14. COMMON CATHODE

STYLE 4:  
 PIN 1. NO CONNECTION  
 2. CATHODE  
 3. CATHODE  
 4. NO CONNECTION  
 5. CATHODE  
 6. NO CONNECTION  
 7. CATHODE  
 8. CATHODE  
 9. CATHODE  
 10. NO CONNECTION  
 11. CATHODE  
 12. CATHODE  
 13. NO CONNECTION  
 14. COMMON ANODE

STYLE 5:  
 PIN 1. COMMON CATHODE  
 2. ANODE/CATHODE  
 3. ANODE/CATHODE  
 4. ANODE/CATHODE  
 5. ANODE/CATHODE  
 6. NO CONNECTION  
 7. COMMON ANODE  
 8. COMMON CATHODE  
 9. ANODE/CATHODE  
 10. ANODE/CATHODE  
 11. ANODE/CATHODE  
 12. ANODE/CATHODE  
 13. NO CONNECTION  
 14. COMMON ANODE

STYLE 6:  
 PIN 1. CATHODE  
 2. CATHODE  
 3. CATHODE  
 4. CATHODE  
 5. CATHODE  
 6. CATHODE  
 7. CATHODE  
 8. ANODE  
 9. ANODE  
 10. ANODE  
 11. ANODE  
 12. ANODE  
 13. ANODE  
 14. ANODE

STYLE 7:  
 PIN 1. ANODE/CATHODE  
 2. COMMON ANODE  
 3. COMMON CATHODE  
 4. ANODE/CATHODE  
 5. ANODE/CATHODE  
 6. ANODE/CATHODE  
 7. ANODE/CATHODE  
 8. ANODE/CATHODE  
 9. ANODE/CATHODE  
 10. ANODE/CATHODE  
 11. COMMON CATHODE  
 12. COMMON ANODE  
 13. ANODE/CATHODE  
 14. ANODE/CATHODE

STYLE 8:  
 PIN 1. COMMON CATHODE  
 2. ANODE/CATHODE  
 3. ANODE/CATHODE  
 4. NO CONNECTION  
 5. ANODE/CATHODE  
 6. ANODE/CATHODE  
 7. COMMON ANODE  
 8. COMMON ANODE  
 9. ANODE/CATHODE  
 10. ANODE/CATHODE  
 11. NO CONNECTION  
 12. ANODE/CATHODE  
 13. ANODE/CATHODE  
 14. COMMON CATHODE

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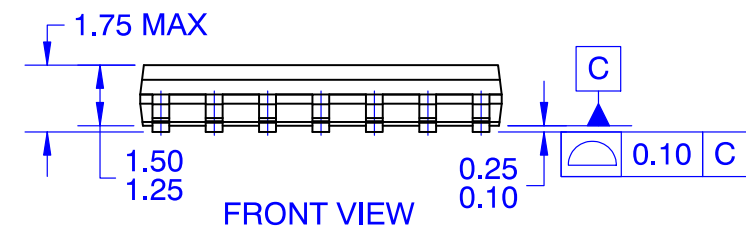
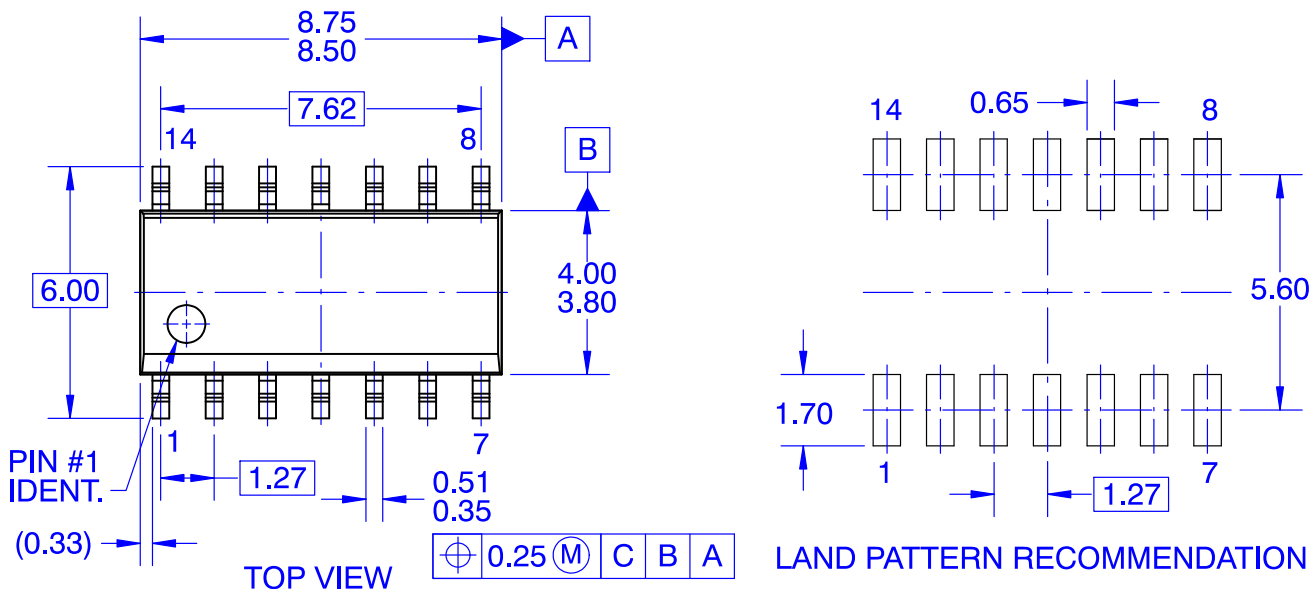
**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**

ON Semiconductor®



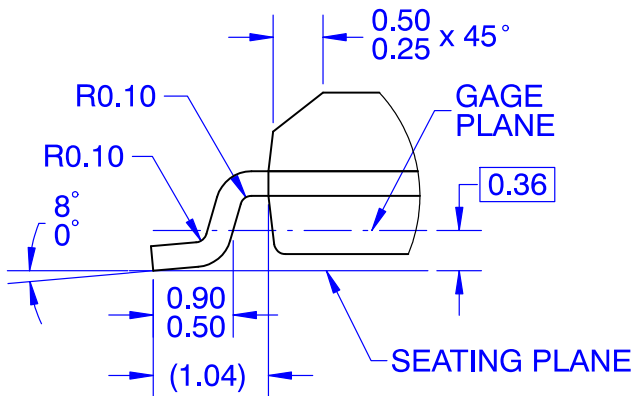
**SOIC14**  
**CASE 751EF**  
**ISSUE O**

DATE 30 SEP 2016



**NOTES:**

- A. CONFORMS TO JEDEC MS-012, VARIATION AB, ISSUE C
- B. ALL DIMENSIONS ARE IN MILLIMETERS
- C. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS
- D. LAND PATTERN STANDARD: SOIC127P600X145-14M
- E. CONFORMS TO ASME Y14.5M, 2009



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