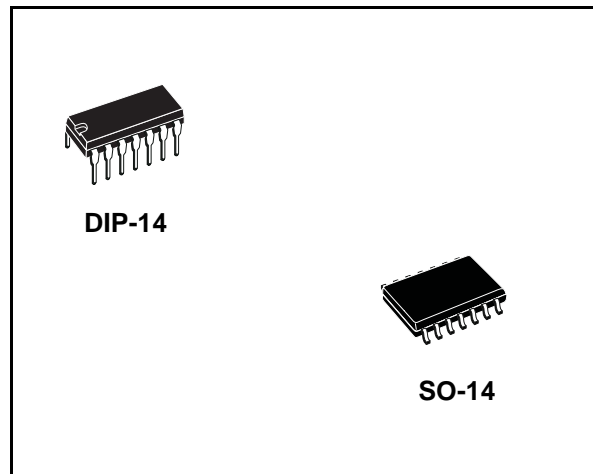


### Features

- High speed:  
 $t_{PD} = 11 \text{ ns (typ.) at } V_{CC} = 4.5 \text{ V}$
- Low power dissipation:  
 $I_{CC} = 1 \mu\text{A (max.) at } T_A = 25 \text{ }^\circ\text{C}$
- Compatible with TTL outputs:  
 $V_{IH} = 2 \text{ V (min.) } V_{IL} = 0.8 \text{ V (max)}$
- Balanced propagation delays:  
 $t_{PLH} \cong t_{PHL}$
- Symmetrical output impedance:  
 $|I_{OH}| = I_{OL} = 4 \text{ mA (min)}$
- Pin and function compatible with 74 series 04



### Description

The M74HCT04 is a high speed CMOS hex inverter fabricated with silicon gate C<sup>2</sup>MOS technology.

The internal circuit is composed of 3 stages including a buffer output, which enables high noise immunity and stable output.

The M74HCT04 is designed to directly interface HSC<sup>2</sup>MOS systems with TTL and NMOS components.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.

**Table 1. Device summary**

| Order code     | Package | Packing       |
|----------------|---------|---------------|
| M74HCT04B1R    | DIP-14  | Tube          |
| M74HCT04RM13TR | SO-14   | Tape and reel |

# 1 Pin connection and IEC logic symbols

Figure 1. Pin connections and IEC logic symbols

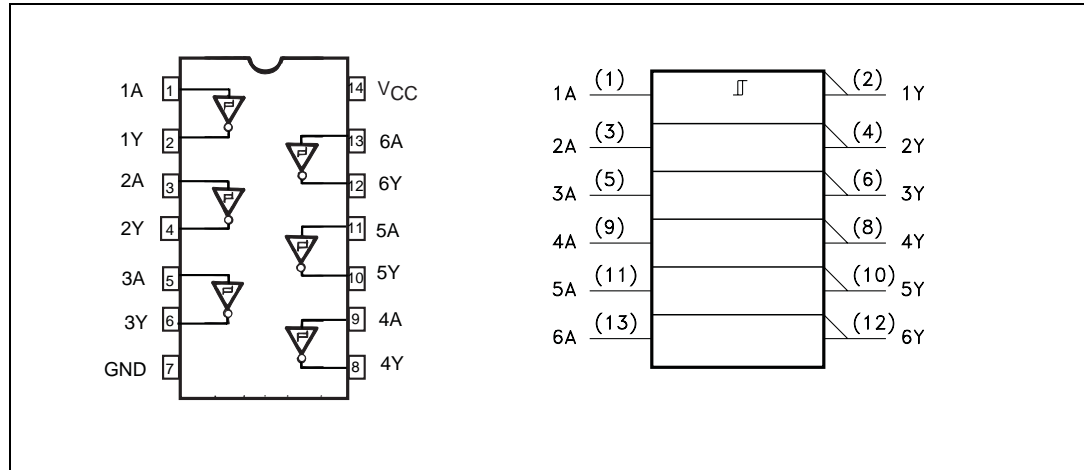


Table 2. Pin description

| Pin number         | Symbol          | Name and function       |
|--------------------|-----------------|-------------------------|
| 1, 3, 5, 9, 11, 13 | 1A to 6A        | Data inputs             |
| 2, 4, 6, 8, 10, 12 | 1Y to 6Y        | Data outputs            |
| 7                  | GND             | Ground (0 V)            |
| 14                 | V <sub>CC</sub> | Positive supply voltage |

Figure 2. Input and output equivalent circuit

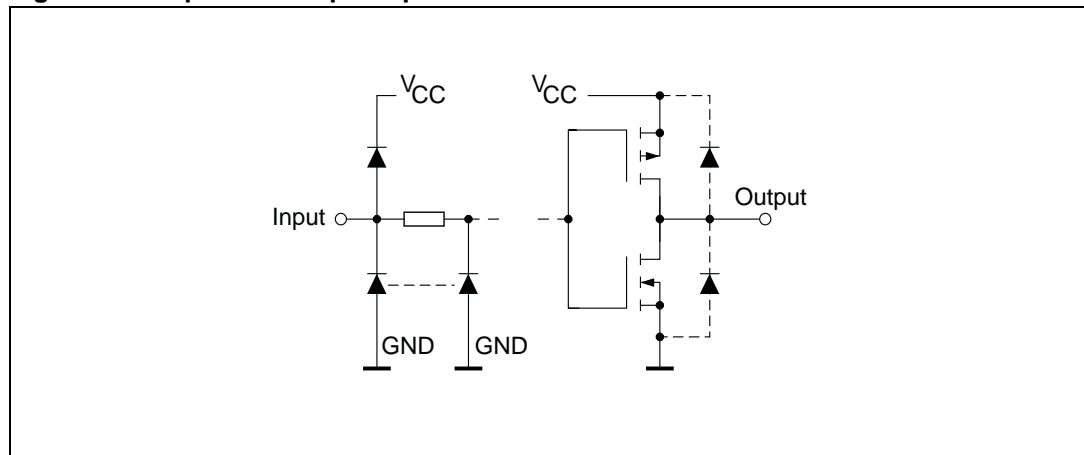


Table 3. Truth table

| A | Y |
|---|---|
| L | H |
| H | L |

## 2 Maximum rating

Stressing the device above the rating listed in the “Absolute maximum ratings” table may cause permanent damage to the device. These are stress ratings only, and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

**Table 4. Absolute maximum ratings**

| Symbol                | Parameter                     | Value                  | Unit |
|-----------------------|-------------------------------|------------------------|------|
| $V_{CC}$              | Supply voltage                | -0.5 to +7             | V    |
| $V_I$                 | DC input voltage              | -0.5 to $V_{CC} + 0.5$ | V    |
| $V_O$                 | DC output voltage             | -0.5 to $V_{CC} + 0.5$ | V    |
| $I_{IK}$              | DC input diode current        | $\pm 20$               | mA   |
| $I_{OK}$              | DC output diode current       | $\pm 20$               | mA   |
| $I_O$                 | DC output current             | $\pm 25$               | mA   |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground current | $\pm 50$               | mA   |
| $P_D$                 | Power dissipation             | 500 <sup>(1)</sup>     | mW   |
| $T_{stg}$             | Storage temperature           | -65 to +150            | °C   |
| $T_L$                 | Lead temperature (10 sec)     | 300                    | °C   |

1. 500 mW at 65 °C; derate to 300 mW by 10 mW/°C from 65 °C to 85 °C

**Table 5. Recommended operating conditions**

| Symbol     | Parameter   | Value         | Unit |
|------------|---|---------------|------|
| $V_{CC}$   | Supply voltage  | 4.5 to 5.5    | V    |
| $V_I$      | Input voltage   | 0 to $V_{CC}$ | V    |
| $V_O$      | Output voltage  | 0 to $V_{CC}$ | V    |
| $T_{op}$   | Operating temperature                                 | -55 to 125    | °C   |
| $t_r, t_f$ | Input rise and fall time ( $V_{CC} = 4.5$ to $5.5$ V) | 0 to 500      | ns   |

**Table 6. DC specifications**

| Symbol            | Parameter                            | Test condition      |   | Value                  |      |      |             |      |              | Unit |     |
|-------------------|--------------------------------------|---------------------|---|------------------------|------|------|-------------|------|--------------|------|-----|
|                   |                                      | V <sub>CC</sub> (V) |   | T <sub>A</sub> = 25 °C |      |      | -40 to 85°C |      | -55 to 125°C |      |     |
|                   |                                      |                     |   | Min                    | Typ  | Max  | Min         | Max  | Min          |      | Max |
| V <sub>IH</sub>   | High level input voltage             | 4.5 to 5.5          |   | 2.0                    |      |      | 2.0         |      | 2.0          |      | V   |
| V <sub>IL</sub>   | Low level input voltage              | 4.5 to 5.5          |   |                        |      | 0.8  |             | 0.8  |              | 0.8  | V   |
| V <sub>OH</sub>   | High level output voltage            | 4.5                 | I <sub>O</sub> = -20 μA   | 4.4                    | 4.5  |      | 4.4         |      | 4.4          |      | V   |
|                   |                                      |                     | I <sub>O</sub> = -4.0 mA  | 4.18                   | 4.31 |      | 4.13        |      | 4.10         |      |     |
| V <sub>OL</sub>   | Low level output voltage             | 4.5                 | I <sub>O</sub> = 20 μA  |                        | 0.0  | 0.1  |             | 0.1  |              | 0.1  | V   |
|                   |                                      |                     | I <sub>O</sub> = 4.0 mA   |                        | 0.17 | 0.26 |             | 0.33 |              | 0.40 |     |
| I <sub>I</sub>    | Input leakage current                | 5.5                 | V <sub>I</sub> = V <sub>CC</sub> or GND   |                        |      | ±0.1 |             | ±1   |              | ±1   | μA  |
| I <sub>CC</sub>   | Quiescent supply current             | 5.5                 | V <sub>I</sub> = V <sub>CC</sub> or GND   |                        |      | 1    |             | 10   |              | 20   | μA  |
| Δ I <sub>CC</sub> | Additional worst case supply current | 5.5                 | Per input pin<br>V <sub>I</sub> = 0.5 V or<br>V <sub>I</sub> = 2.4 V<br>Other inputs at<br>V <sub>CC</sub> or GND<br>I <sub>O</sub> = 0 |                        |      | 2.0  |             | 2.9  |              | 3.0  | mA  |

**Table 7. AC electrical characteristics (C<sub>L</sub> = 50 pF, input t<sub>r</sub> = t<sub>f</sub> = 6 ns)**

| Symbol                            | Parameter              | Test condition      |  | Value                 |      |      |             |      |              | Unit |      |
|-----------------------------------|------------------------|---------------------|--|-----------------------|------|------|-------------|------|--------------|------|------|
|                                   |                        | V <sub>CC</sub> (V) |  | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |      |      |
|                                   |                        |                     |  | Min.                  | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| t <sub>TLH</sub> t <sub>THL</sub> | Output transition time | 4.5                 |  |                       | 8    | 15   |             | 19   |              | 23   | ns   |
| t <sub>PLH</sub> t <sub>PHL</sub> | Propagation delay time | 4.5                 |  |                       | 11   | 18   |             | 23   |              | 27   | ns   |

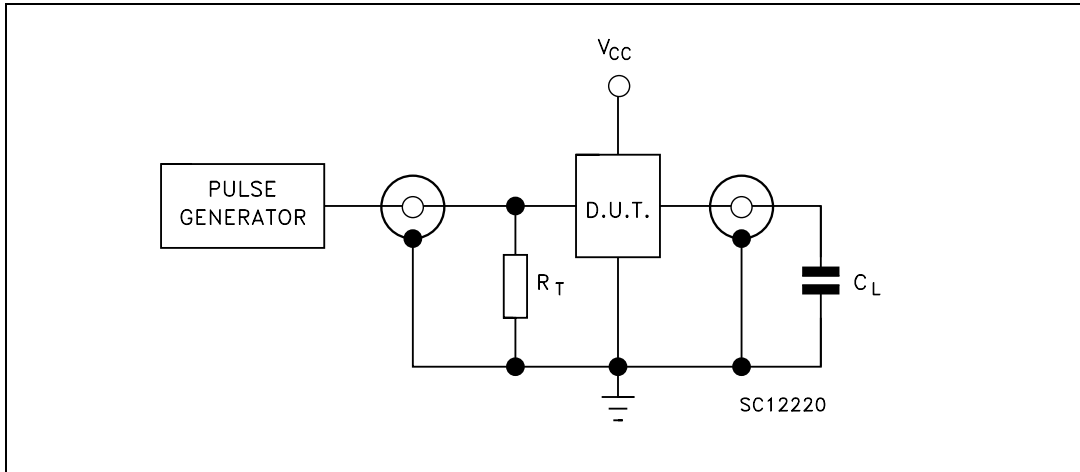
Table 8. Capacitive characteristics

| Symbol          | Parameter                                    | Test condition         |  | Value                 |     |     |             |     |              | Unit |     |
|-----------------|--|------------------------|--|-----------------------|-----|-----|-------------|-----|--------------|------|-----|
|                 |  | V <sub>CC</sub><br>(V) |  | T <sub>A</sub> = 25°C |     |     | -40 to 85°C |     | -55 to 125°C |      |     |
|                 |  |                        |  | Min                   | Typ | Max | Min         | Max | Min          |      | Max |
| C <sub>IN</sub> | Input capacitance                            |                        |  |                       | 5   | 10  |             | 10  |              | 10   | pF  |
| C <sub>PD</sub> | Power dissipation capacitance <sup>(1)</sup> |                        |  |                       | 20  |     |             |     |              |      | pF  |

1. C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  
 $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/6$  (per gate)

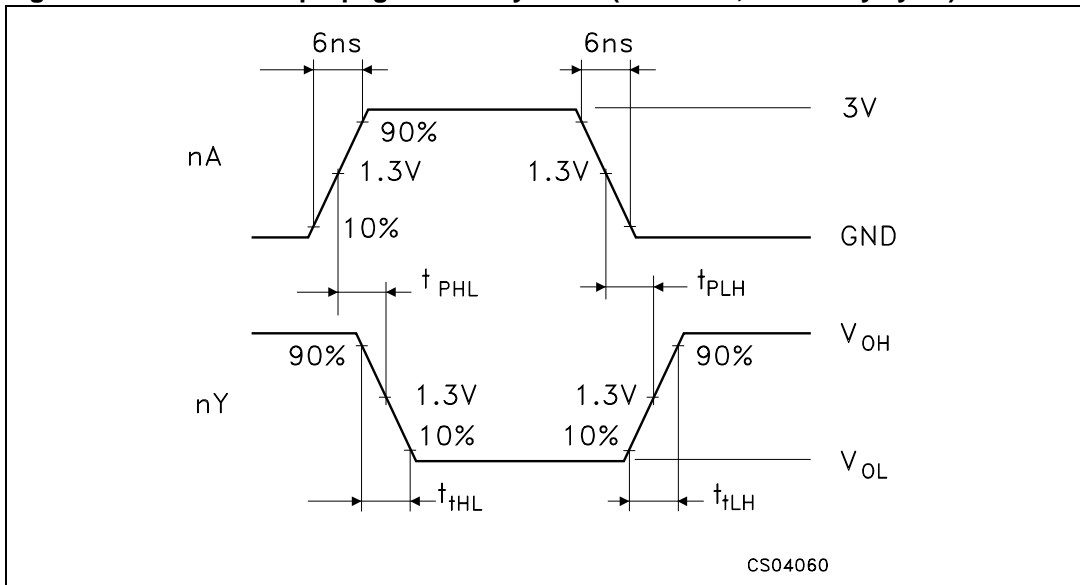
### 3 Test circuit

Figure 3. Test circuit



1.  $C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)
2.  $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

Figure 4. Waveform: propagation delay times ( $f = 1\text{ MHz}$ ;  $50\%$  duty cycle)

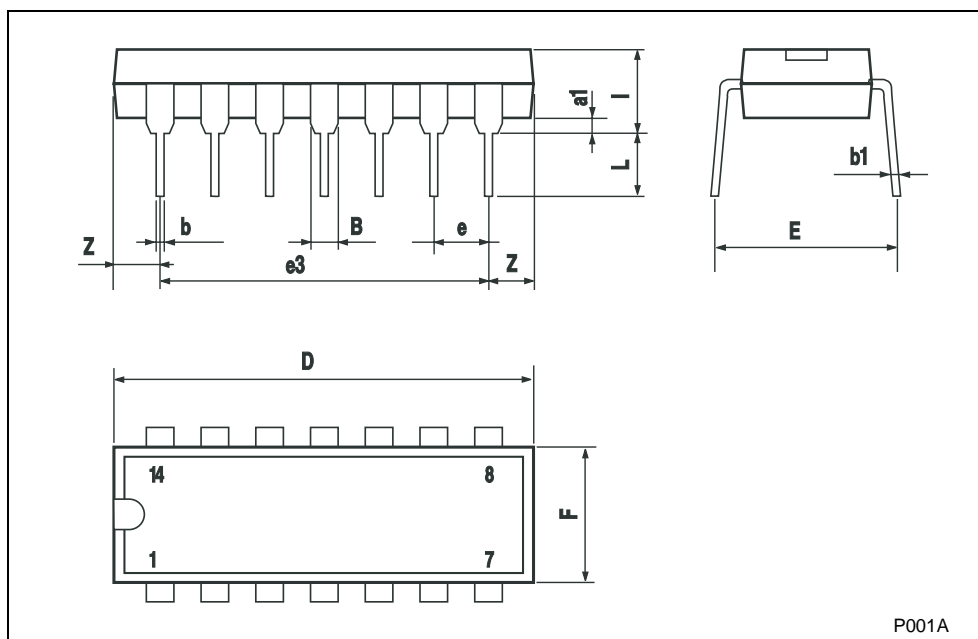


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com).

**Plastic DIP-14 MECHANICAL DATA**

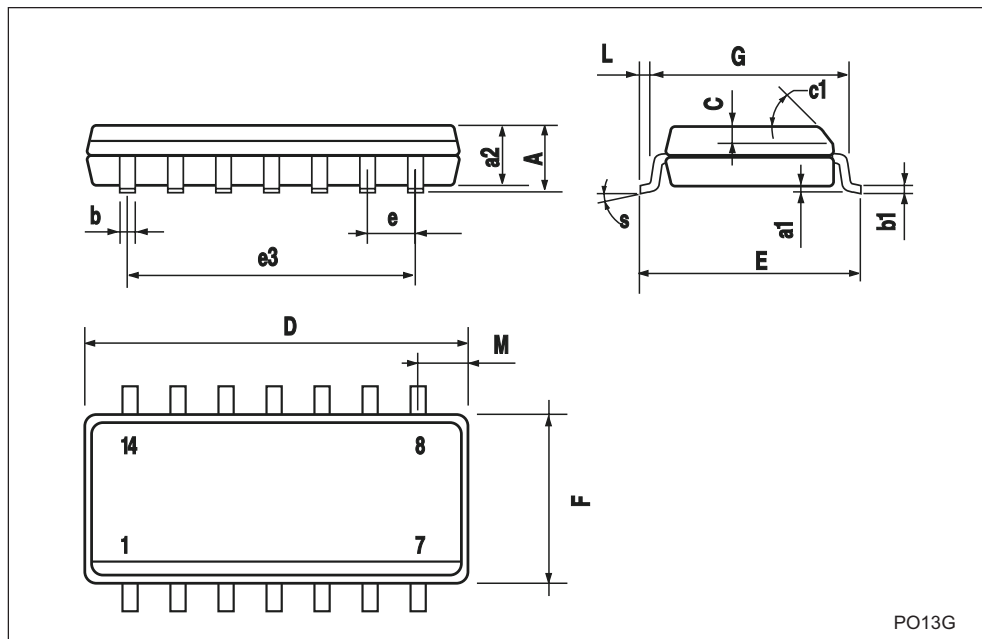
| DIM. | mm.  |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP   | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 1.39 |       | 1.65 | 0.055 |       | 0.065 |
| b    |      | 0.5   |      |       | 0.020 |       |
| b1   |      | 0.25  |      |       | 0.010 |       |
| D    |      |       | 20   |       |       | 0.787 |
| E    |      | 8.5   |      |       | 0.335 |       |
| e    |      | 2.54  |      |       | 0.100 |       |
| e3   |      | 15.24 |      |       | 0.600 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| l    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    | 1.27 |       | 2.54 | 0.050 |       | 0.100 |





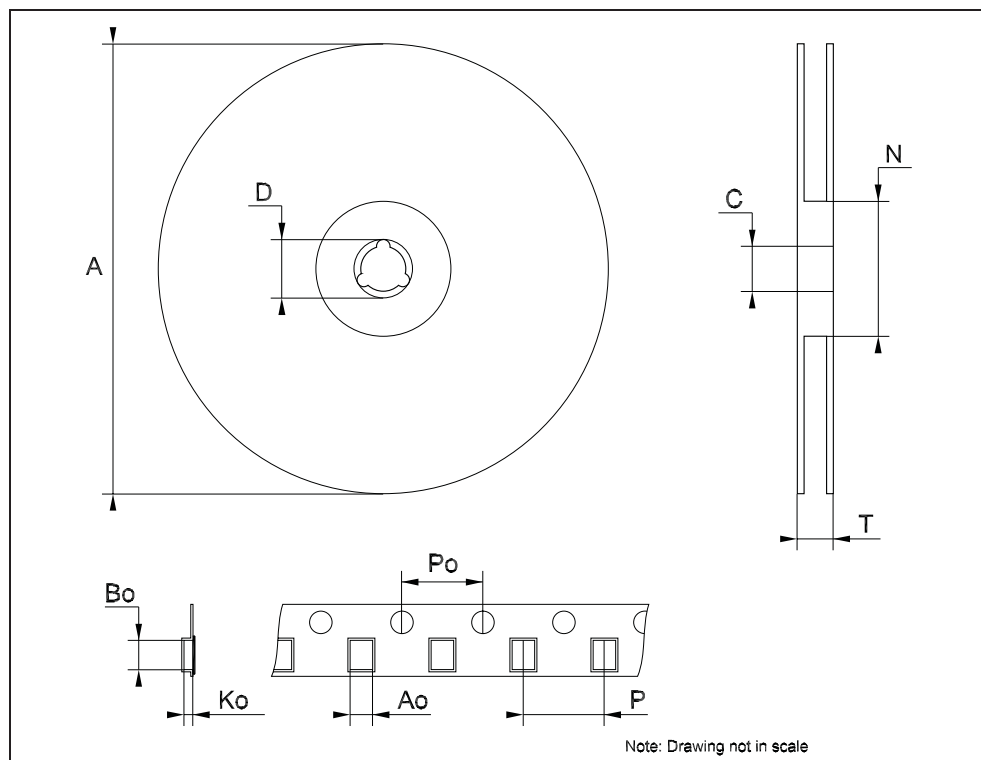
**SO-14 MECHANICAL DATA**

| DIM. | mm.        |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.003 |       | 0.007 |
| a2   |            |      | 1.65 |       |       | 0.064 |
| b    | 0.35       |      | 0.46 | 0.013 |       | 0.018 |
| b1   | 0.19       |      | 0.25 | 0.007 |       | 0.010 |
| C    |            | 0.5  |      |       | 0.019 |       |
| c1   | 45° (typ.) |      |      |       |       |       |
| D    | 8.55       |      | 8.75 | 0.336 |       | 0.344 |
| E    | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e    |            | 1.27 |      |       | 0.050 |       |
| e3   |            | 7.62 |      |       | 0.300 |       |
| F    | 3.8        |      | 4.0  | 0.149 |       | 0.157 |
| G    | 4.6        |      | 5.3  | 0.181 |       | 0.208 |
| L    | 0.5        |      | 1.27 | 0.019 |       | 0.050 |
| M    |            |      | 0.68 |       |       | 0.026 |
| S    | 8° (max.)  |      |      |       |       |       |



**Tape & Reel SO-14 MECHANICAL DATA**

| DIM. | mm.  |     |      | inch  |      |        |
|------|------|-----|------|-------|------|--------|
|      | MIN. | TYP | MAX. | MIN.  | TYP. | MAX.   |
| A    |      |     | 330  |       |      | 12.992 |
| C    | 12.8 |     | 13.2 | 0.504 |      | 0.519  |
| D    | 20.2 |     |      | 0.795 |      |        |
| N    | 60   |     |      | 2.362 |      |        |
| T    |      |     | 22.4 |       |      | 0.882  |
| Ao   | 6.4  |     | 6.6  | 0.252 |      | 0.260  |
| Bo   | 9    |     | 9.2  | 0.354 |      | 0.362  |
| Ko   | 2.1  |     | 2.3  | 0.082 |      | 0.090  |
| Po   | 3.9  |     | 4.1  | 0.153 |      | 0.161  |
| P    | 7.9  |     | 8.1  | 0.311 |      | 0.319  |



## 5 Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| July-2001   | 1        | Initial release.   |
| 23-May-2008 | 2        | Document converted and restructured to new template.<br>Removed: M74HC04M1R and M74HCT04TTR order codes.<br>Added: tape and reel specifications for SO-14 package. |