

# DATA SHEET

## **74ALVC04** Hex inverter

Product specification  
Supersedes data of 2003 Feb 04

2003 May 14

## Hex inverter

## 74ALVC04

## FEATURES

- Wide supply voltage range from 1.65 to 3.6 V
- 3.6 V tolerant inputs/outputs
- CMOS low power consumption
- Direct interface with TTL levels (2.7 to 3.6 V)
- Power-down mode
- Latch-up performance exceeds 250 mA
- Complies with JEDEC standard:  
JESD8-7 (1.65 to 1.95 V)  
JESD8-5 (2.3 to 2.7 V)  
JESD8B/JESD36 (2.7 to 3.6 V).
- ESD protection:  
HBM EIA/JESD22-A114-A exceeds 2000 V  
MM EIA/JESD22-A115-A exceeds 200 V.

## DESCRIPTION

The 74ALVC04 is a high-performance, low-power, low-voltage, Si-gate CMOS device and superior to most advanced CMOS compatible TTL families.

Schmitt-trigger action at all inputs makes the circuit tolerant for slower input rise and fall times.

The 74ALVC04 provides six inverting buffers.

## QUICK REFERENCE DATA

GND = 0 V;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

| SYMBOL            | PARAMETER                                | CONDITIONS                                                           | TYPICAL | UNIT |
|-------------------|------------------------------------------|----------------------------------------------------------------------|---------|------|
| $t_{PHL}/t_{PLH}$ | propagation delay nA to nY               | $V_{CC} = 1.8\text{ V}; C_L = 30\text{ pF}; R_L = 1\text{ k}\Omega$  | 2.4     | ns   |
|                   |                                          | $V_{CC} = 2.5\text{ V}; C_L = 30\text{ pF}; R_L = 500\text{ }\Omega$ | 1.8     | ns   |
|                   |                                          | $V_{CC} = 2.7\text{ V}; C_L = 50\text{ pF}; R_L = 500\text{ }\Omega$ | 2.3     | ns   |
|                   |                                          | $V_{CC} = 3.3\text{ V}; C_L = 50\text{ pF}; R_L = 500\text{ }\Omega$ | 2.0     | ns   |
| $C_I$             | input capacitance                        |                                                                      | 3.5     | pF   |
| $C_{PD}$          | power dissipation capacitance per buffer | $V_{CC} = 3.3\text{ V}$ ; notes 1 and 2                              | 26      | pF   |

## Notes

1.  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$  where:

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in Volts;

$N$  = total load switching outputs;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs.

2. The condition is  $V_I = \text{GND to } V_{CC}$ .

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ORDERING INFORMATION

| TYPE NUMBER | PACKAGE           |      |          |          |          |
|-------------|-------------------|------|----------|----------|----------|
|             | TEMPERATURE RANGE | PINS | PACKAGE  | MATERIAL | CODE     |
| 74ALVC04D   | −40 to +85 °C     | 14   | SO14     | plastic  | SOT108-1 |
| 74ALVC04PW  | −40 to +85 °C     | 14   | TSSOP14  | plastic  | SOT402-1 |
| 74ALVC04BQ  | −40 to +85 °C     | 14   | DHVQFN14 | plastic  | SOT762-1 |

FUNCTION TABLE

See note 1.

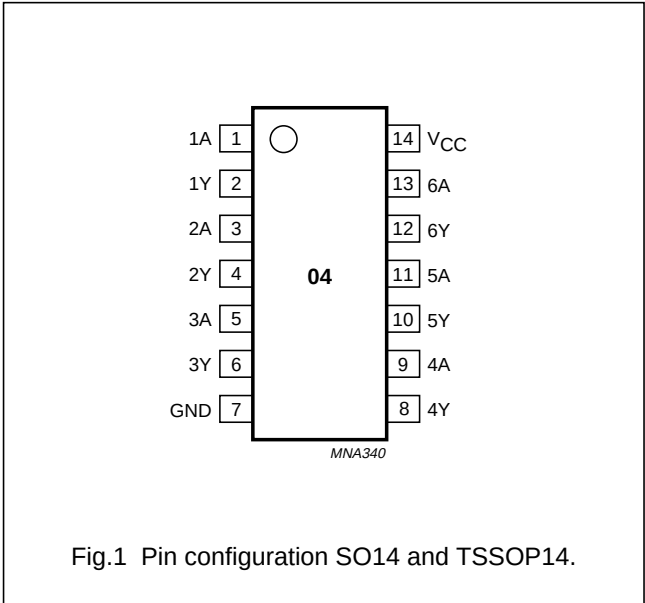
| INPUT | OUTPUT |
|-------|--------|
| nA    | nY     |
| L     | H      |
| H     | L      |

Note

1. H = HIGH voltage level;  
a) L = LOW voltage level.

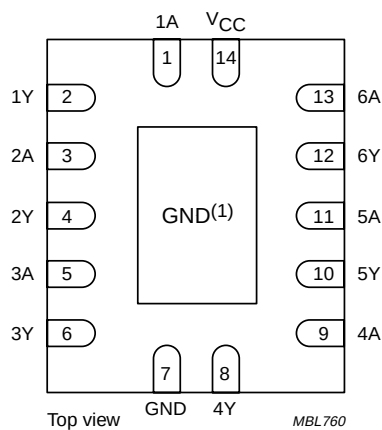
PINNING

| PIN | SYMBOL          | DESCRIPTION    |
|-----|-----------------|----------------|
| 1   | 1A              | data input     |
| 2   | 1Y              | data output    |
| 3   | 2A              | data input     |
| 4   | 2Y              | data output    |
| 5   | 3A              | data input     |
| 6   | 3Y              | data output    |
| 7   | GND             | ground (0 V)   |
| 8   | 4Y              | data output    |
| 9   | 4A              | data input     |
| 10  | 5Y              | data output    |
| 11  | 5A              | data input     |
| 12  | 6Y              | data output    |
| 13  | 6A              | data input     |
| 14  | V <sub>CC</sub> | supply voltage |



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(1) The die substrate is attached to this pad using conductive die attach material. It can not be used as a supply pin of input.

Fig.2 Pin configuration DHVQFN14.

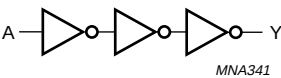


Fig.3 Logic diagram (one inverter).

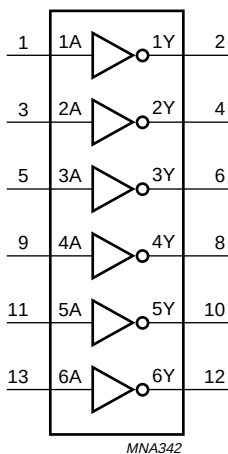


Fig.4 Logic symbol.

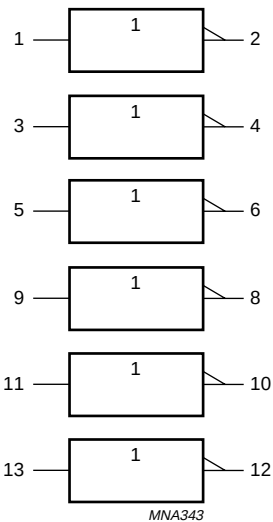


Fig.5 IEC logic symbol.

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## RECOMMENDED OPERATING CONDITIONS

| SYMBOL     | PARAMETER                     | CONDITIONS                      | MIN. | MAX.     | UNIT |
|------------|-------------------------------|---------------------------------|------|----------|------|
| $V_{CC}$   | supply voltage                |                                 | 1.65 | 3.6      | V    |
| $V_I$      | input voltage                 |                                 | 0    | 3.6      | V    |
| $V_O$      | output voltage                | $V_{CC} = 1.65$ to $3.6$ V      | 0    | $V_{CC}$ | V    |
|            |                               | $V_{CC} = 0$ V; Power-down mode | 0    | 3.6      | V    |
| $T_{amb}$  | operating ambient temperature |                                 | -40  | +85      | °C   |
| $t_r, t_f$ | input rise and fall times     | $V_{CC} = 1.65$ to $2.7$ V      | 0    | 20       | ns/V |
|            |                               | $V_{CC} = 2.7$ to $3.6$ V       | 0    | 10       | ns/V |

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134); voltages are referenced to GND (ground = 0 V).

| SYMBOL            | PARAMETER                     | CONDITIONS                          | MIN. | MAX.           | UNIT |
|-------------------|-------------------------------|-------------------------------------|------|----------------|------|
| $V_{CC}$          | supply voltage                |                                     | -0.5 | +4.6           | V    |
| $I_{IK}$          | input diode current           | $V_I < 0$                           | -    | -50            | mA   |
| $V_I$             | input voltage                 |                                     | -0.5 | +4.6           | V    |
| $I_{OK}$          | output diode current          | $V_O > V_{CC}$ or $V_O < 0$         | -    | ±50            | mA   |
| $V_O$             | output voltage                | notes 1 and 2                       | -0.5 | $V_{CC} + 0.5$ | V    |
|                   |                               | Power-down mode; note 2             | -0.5 | +4.6           | V    |
| $I_O$             | output source or sink current | $V_O = 0$ to $V_{CC}$               | -    | ±50            | mA   |
| $I_{CC}, I_{GND}$ | $V_{CC}$ or GND current       |                                     | -    | ±100           | mA   |
| $T_{stg}$         | storage temperature           |                                     | -65  | +150           | °C   |
| $P_{tot}$         | power dissipation             | $T_{amb} = -40$ to $+85$ °C; note 3 | -    | 500            | mW   |

## Notes

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. When  $V_{CC} = 0$  V (Power-down mode), the output voltage can be 3.6 V in normal operation.
3. For SO14 packages: above 70 °C derate linearly with 8 mW/K.
  - a) For TSSOP14 packages: above 60 °C derate linearly with 5.5 mW/K.
  - b) For DHVQFN14 packages: above 60 °C derate linearly with 4.5 mW/K.

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## DC CHARACTERISTICS

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| SYMBOL                           | PARAMETER                                         | TEST CONDITIONS                                                                                                                                                                                                                                  |                     | MIN.                   | TYP. <sup>(1)</sup> | MAX.                   | UNIT |
|----------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------|---------------------|------------------------|------|
|                                  |                                                   | OTHER                                                                                                                                                                                                                                            | V <sub>CC</sub> (V) |                        |                     |                        |      |
| T <sub>amb</sub> = –40 to +85 °C |                                                   |                                                                                                                                                                                                                                                  |                     |                        |                     |                        |      |
| V <sub>IH</sub>                  | HIGH-level input voltage                          |                                                                                                                                                                                                                                                  | 1.65 to 1.95        | 0.65 × V <sub>CC</sub> | –                   | –                      | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 2.3 to 2.7          | 1.7                    | –                   | –                      | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 2.7 to 3.6          | 2                      | –                   | –                      | V    |
| V <sub>IL</sub>                  | LOW-level input voltage                           |                                                                                                                                                                                                                                                  | 1.65 to 1.95        | –                      | –                   | 0.35 × V <sub>CC</sub> | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 2.3 to 2.7          | –                      | –                   | 0.7                    | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 2.7 to 3.6          | –                      | –                   | 0.8                    | V    |
| V <sub>OL</sub>                  | LOW-level output voltage                          | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>O</sub> = 100 μA<br>I <sub>O</sub> = 6 mA<br>I <sub>O</sub> = 12 mA<br>I <sub>O</sub> = 18 mA<br>I <sub>O</sub> = 12 mA<br>I <sub>O</sub> = 18 mA<br>I <sub>O</sub> = 24 mA        | 1.65 to 3.6         | –                      | –                   | 0.2                    | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 1.65                | –                      | 0.11                | 0.3                    | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 2.3                 | –                      | 0.17                | 0.4                    | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 2.3                 | –                      | 0.25                | 0.6                    | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 2.7                 | –                      | 0.16                | 0.4                    | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 3.0                 | –                      | 0.23                | 0.4                    | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 3.0                 | –                      | 0.30                | 0.55                   | V    |
| V <sub>OH</sub>                  | HIGH-level output voltage                         | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>O</sub> = –100 μA<br>I <sub>O</sub> = –6 mA<br>I <sub>O</sub> = –12 mA<br>I <sub>O</sub> = –18 mA<br>I <sub>O</sub> = –12 mA<br>I <sub>O</sub> = –18 mA<br>I <sub>O</sub> = –24 mA | 1.65 to 3.6         | V <sub>CC</sub> – 0.2  | –                   | –                      | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 1.65                | 1.25                   | 1.51                | –                      | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 2.3                 | 1.8                    | 2.10                | –                      | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 2.3                 | 1.7                    | 2.01                | –                      | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 2.7                 | 2.2                    | 2.53                | –                      | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 3.0                 | 2.4                    | 2.76                | –                      | V    |
|                                  |                                                   |                                                                                                                                                                                                                                                  | 3.0                 | 2.2                    | 2.68                | –                      | V    |
| I <sub>LI</sub>                  | input leakage current                             | V <sub>I</sub> = 3.6 V or GND                                                                                                                                                                                                                    | 3.6                 | –                      | ±0.1                | ±5                     | μA   |
| I <sub>off</sub>                 | power OFF leakage current                         | V <sub>I</sub> or V <sub>O</sub> = 3.6 V                                                                                                                                                                                                         | 0.0                 | –                      | ±0.1                | ±10                    | μA   |
| I <sub>CC</sub>                  | quiescent supply current                          | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0                                                                                                                                                                                      | 3.6                 | –                      | 0.2                 | 20                     | μA   |
| ΔI <sub>CC</sub>                 | additional quiescent supply current per input pin | V <sub>I</sub> = V <sub>CC</sub> – 0.6 V; I <sub>O</sub> = 0                                                                                                                                                                                     | 3.0 to 3.6          | –                      | 5                   | 750                    | μA   |

## Note

1. All typical values are measured at T<sub>amb</sub> = 25 °C.

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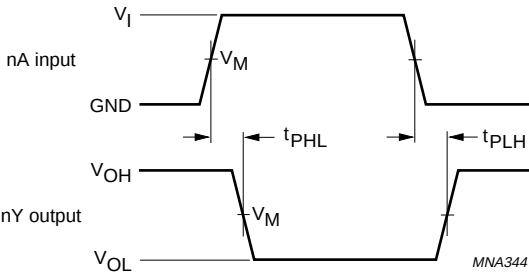
AC CHARACTERISTICS

| SYMBOL                             | PARAMETER                     | TEST CONDITIONS  |                     | MIN. | TYP. <sup>(1)</sup> | MAX. | UNIT |
|------------------------------------|-------------------------------|------------------|---------------------|------|---------------------|------|------|
|                                    |                               | WAVEFORMS        | V <sub>CC</sub> (V) |      |                     |      |      |
| T <sub>amb</sub> = −40 to +85 °C   |                               |                  |                     |      |                     |      |      |
| t <sub>PHL</sub> /t <sub>PLH</sub> | propagation delay<br>nA to nY | see Figs 6 and 7 | 1.65 to 1.95        | 1.0  | 2.4                 | 4.4  | ns   |
|                                    |                               |                  | 2.3 to 2.7          | 1.0  | 1.8                 | 3.0  | ns   |
|                                    |                               |                  | 2.7                 | 1.0  | 2.3                 | 3.3  | ns   |
|                                    |                               |                  | 3.0 to 3.6          | 1.0  | 2.0                 | 2.8  | ns   |

Note

1. All typical values are measured at T<sub>amb</sub> = 25 °C.

AC WAVEFORMS

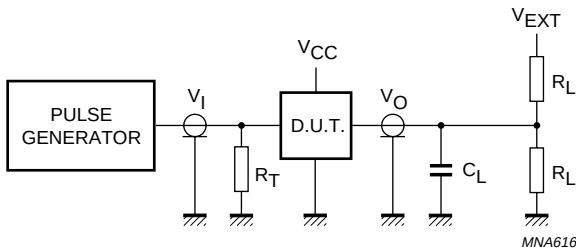


| V <sub>CC</sub> | V <sub>M</sub>        | INPUT           |                                 |
|-----------------|-----------------------|-----------------|---------------------------------|
|                 |                       | V <sub>I</sub>  | t <sub>r</sub> = t <sub>f</sub> |
| 1.65 to 1.95 V  | 0.5 × V <sub>CC</sub> | V <sub>CC</sub> | ≤ 2.0 ns                        |
| 2.3 to 2.7 V    | 0.5 × V <sub>CC</sub> | V <sub>CC</sub> | ≤ 2.0 ns                        |
| 2.7 V           | 1.5 V                 | 2.7 V           | ≤ 2.5 ns                        |
| 3.0 to 3.6 V    | 1.5 V                 | 2.7 V           | ≤ 2.5 ns                        |

Fig.6 Inputs nA to output nY propagation delay times.

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| V <sub>CC</sub> | V <sub>I</sub>  | C <sub>L</sub> | R <sub>L</sub> | V <sub>EXT</sub>                   |                                    |                                    |
|-----------------|-----------------|----------------|----------------|------------------------------------|------------------------------------|------------------------------------|
|                 |                 |                |                | t <sub>PLH</sub> /t <sub>PHL</sub> | t <sub>PZH</sub> /t <sub>PHZ</sub> | t <sub>PZL</sub> /t <sub>PLZ</sub> |
| 1.65 to 1.95 V  | V <sub>CC</sub> | 30 pF          | 1 kΩ           | open                               | GND                                | 2 × V <sub>CC</sub>                |
| 2.3 to 2.7 V    | V <sub>CC</sub> | 30 pF          | 500 Ω          | open                               | GND                                | 2 × V <sub>CC</sub>                |
| 2.7 V           | 2.7 V           | 50 pF          | 500 Ω          | open                               | GND                                | 6 V                                |
| 3.0 to 3.6 V    | 2.7 V           | 50 pF          | 500 Ω          | open                               | GND                                | 6 V                                |

Definitions for test circuit:  
R<sub>L</sub> = Load resistor.  
C<sub>L</sub> = Load capacitance including jig and probe capacitance.  
R<sub>T</sub> = Termination resistance should be equal to the output impedance Z<sub>o</sub> of the pulse generator.

Fig.7 Load circuitry for switching times.



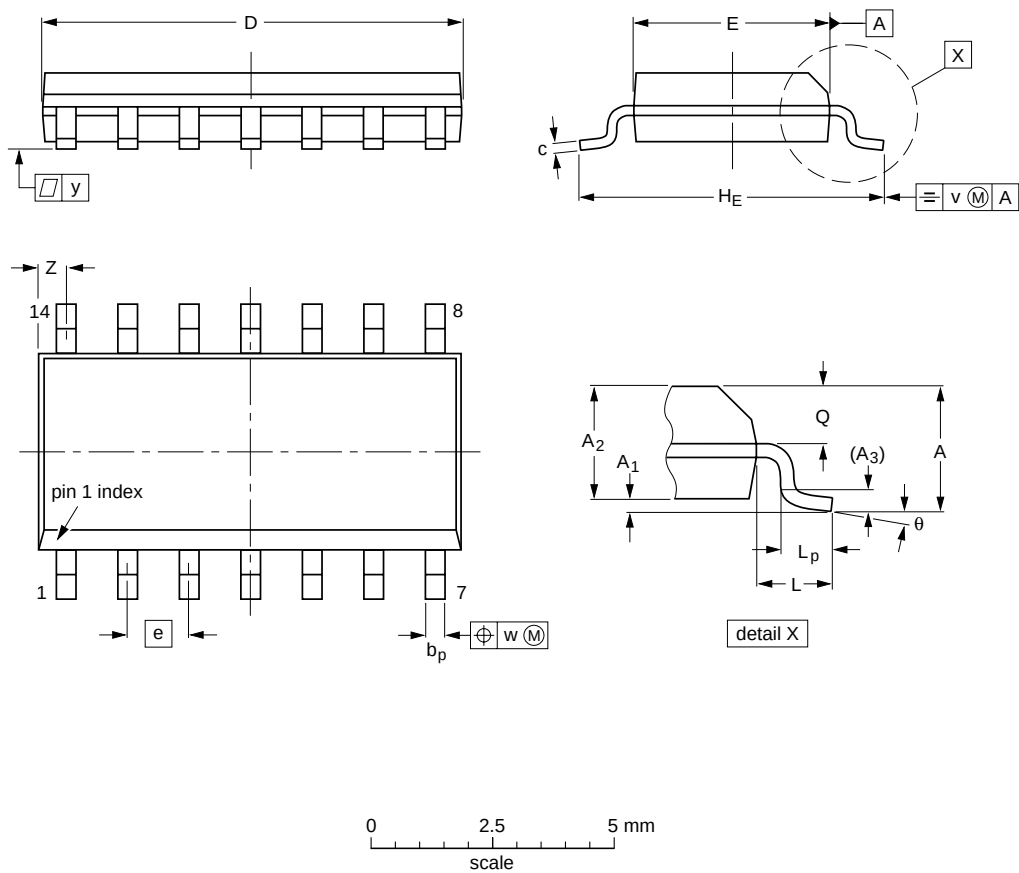
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PACKAGE OUTLINES

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1

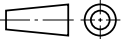


DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT   | A<br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c                | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | H <sub>E</sub> | L     | L <sub>p</sub> | Q              | v    | w    | y     | z <sup>(1)</sup> | θ        |
|--------|-----------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm     | 1.75      | 0.25<br>0.10   | 1.45<br>1.25   | 0.25           | 0.49<br>0.36   | 0.25<br>0.19     | 8.75<br>8.55     | 4.0<br>3.8       | 1.27 | 6.2<br>5.8     | 1.05  | 1.0<br>0.4     | 0.7<br>0.6     | 0.25 | 0.25 | 0.1   | 0.7<br>0.3       | 8°<br>0° |
| inches | 0.069     | 0.010<br>0.004 | 0.057<br>0.049 | 0.01           | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.35<br>0.34     | 0.16<br>0.15     | 0.05 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.024 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012   |          |

Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

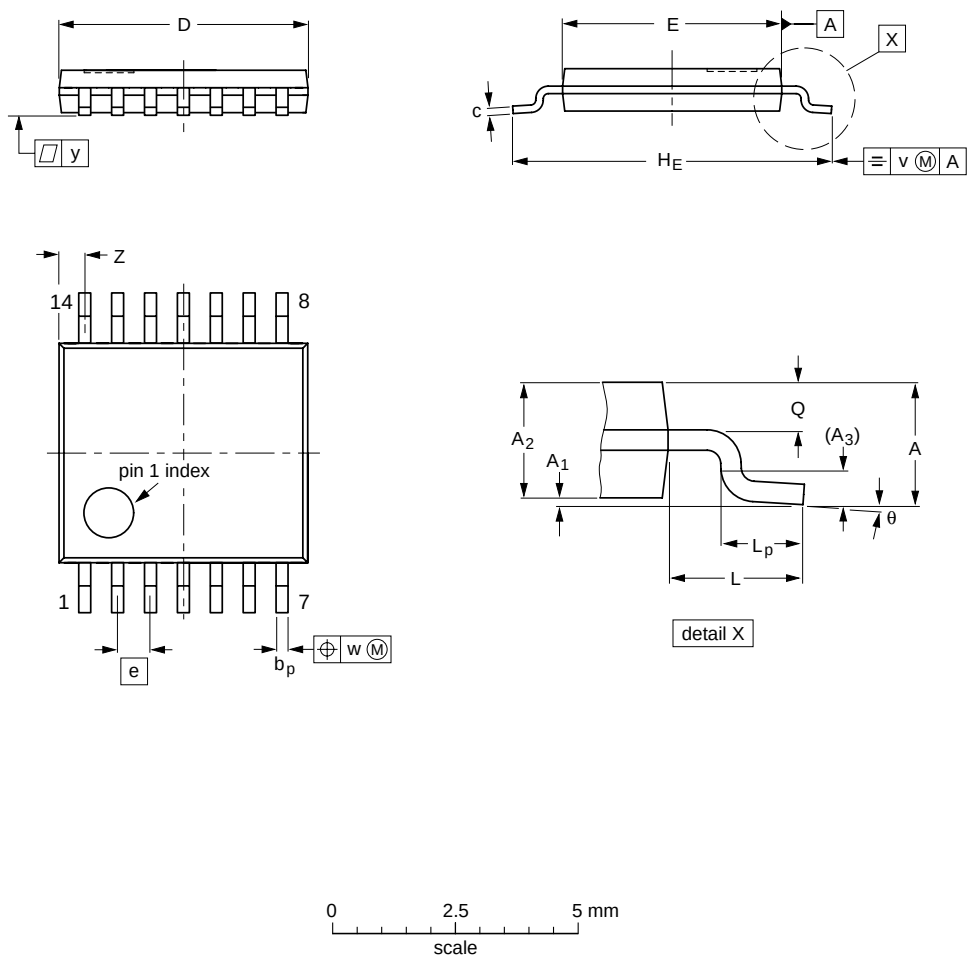
| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION                                                                | ISSUE DATE           |
|--------------------|------------|--------|-------|--|---------------------------------------------------------------------------------------|----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                                                                                       |                      |
| SOT108-1           | 076E06     | MS-012 |       |  |  | 99-12-27<br>03-02-19 |

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TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A<br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c          | D <sup>(1)</sup> | E <sup>(2)</sup> | e    | H <sub>E</sub> | L | L <sub>p</sub> | Q          | v   | w    | y   | z <sup>(1)</sup> | θ        |
|------|-----------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|---|----------------|------------|-----|------|-----|------------------|----------|
| mm   | 1.1       | 0.15<br>0.05   | 0.95<br>0.80   | 0.25           | 0.30<br>0.19   | 0.2<br>0.1 | 5.1<br>4.9       | 4.5<br>4.3       | 0.65 | 6.6<br>6.2     | 1 | 0.75<br>0.50   | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.72<br>0.38     | 8°<br>0° |

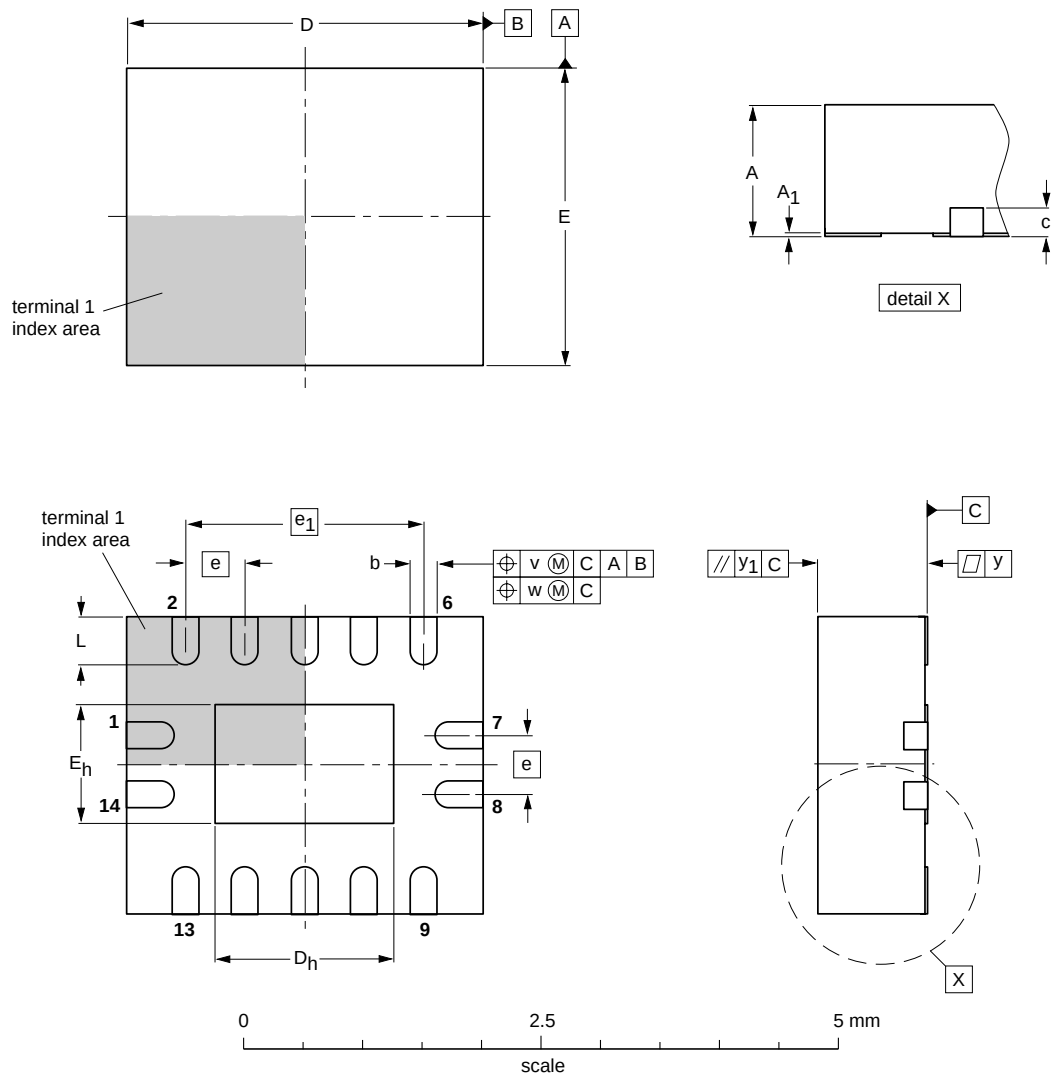
- Notes
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
  2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE            |
|--------------------|------------|--------|-------|--|------------------------|-----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                        |                       |
| SOT402-1           |            | MO-153 |       |  |                        | 99-12-27-<br>03-02-18 |

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DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm SOT762-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A <sup>(1)</sup><br>max. | A <sub>1</sub> | b            | c   | D <sup>(1)</sup> | D <sub>h</sub> | E <sup>(1)</sup> | E <sub>h</sub> | e   | e <sub>1</sub> | L          | v   | w    | y    | y <sub>1</sub> |
|------|--------------------------|----------------|--------------|-----|------------------|----------------|------------------|----------------|-----|----------------|------------|-----|------|------|----------------|
| mm   | 1                        | 0.05<br>0.00   | 0.30<br>0.18 | 0.2 | 3.1<br>2.9       | 1.65<br>1.35   | 2.6<br>2.4       | 1.15<br>0.85   | 0.5 | 2              | 0.5<br>0.3 | 0.1 | 0.05 | 0.05 | 0.1            |

Note  
1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|--------|-------|--|------------------------|----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                        |                      |
| SOT762-1           | ---        | MO-241 | ---   |  |                        | 02-10-17<br>03-01-27 |

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**SOLDERING****Introduction to soldering surface mount packages**

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering can still be used for certain surface mount ICs, but it is not suitable for fine pitch SMDs. In these situations reflow soldering is recommended.

**Reflow soldering**

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several methods exist for reflowing; for example, convection or convection/infrared heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 250 °C. The top-surface temperature of the packages should preferably be kept:

- below 220 °C for all the BGA packages and packages with a thickness  $\geq 2.5$  mm and packages with a thickness  $< 2.5$  mm and a volume  $\geq 350$  mm<sup>3</sup> so called thick/large packages
- below 235 °C for packages with a thickness  $< 2.5$  mm and a volume  $< 350$  mm<sup>3</sup> so called small/thin packages.

**Wave soldering**

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
  - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
  - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

The footprint must incorporate solder thieves at the downstream end.

- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

**Manual soldering**

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C.

When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

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## Suitability of surface mount IC packages for wave and reflow soldering methods

| PACKAGE <sup>(1)</sup>                                                   | SOLDERING METHOD                  |                       |
|--------------------------------------------------------------------------|-----------------------------------|-----------------------|
|                                                                          | WAVE                              | REFLOW <sup>(2)</sup> |
| BGA, LBGA, LFBGA, SQFP, TFBGA, VFBGA                                     | not suitable                      | suitable              |
| DHVQFN, HBCC, HBGA, HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, HVQFN, HVSON, SMS | not suitable <sup>(3)</sup>       | suitable              |
| PLCC <sup>(4)</sup> , SO, SOJ                                            | suitable                          | suitable              |
| LQFP, QFP, TQFP                                                          | not recommended <sup>(4)(5)</sup> | suitable              |
| SSOP, TSSOP, VSO, VSSOP                                                  | not recommended <sup>(6)</sup>    | suitable              |

## Notes

1. For more detailed information on the BGA packages refer to the “(LF)BGA Application Note” (AN01026); order a copy from your Philips Semiconductors sales office.
2. All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the “Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods”.
3. These packages are not suitable for wave soldering. On versions with the heatsink on the bottom side, the solder cannot penetrate between the printed-circuit board and the heatsink. On versions with the heatsink on the top side, the solder might be deposited on the heatsink surface.
4. If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
5. Wave soldering is suitable for LQFP, TQFP and QFP packages with a pitch (e) larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
6. Wave soldering is suitable for SSOP, TSSOP, VSO and VSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.

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## DATA SHEET STATUS

| LEVEL | DATA SHEET STATUS <sup>(1)</sup> | PRODUCT STATUS <sup>(2)(3)</sup> | DEFINITION                                                                                                                                                                                                                                                                                     |
|-------|----------------------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I     | Objective data                   | Development                      | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.                                                                                                    |
| II    | Preliminary data                 | Qualification                    | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.             |
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## Notes

1. Please consult the most recently issued data sheet before initiating or completing a design.
2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.
3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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**NOTES**

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