

# 74LV04

## Hex inverter

Rev. 4 — 8 December 2015

Product data sheet

## 1. General description

The 74LV04 is a low-voltage Si-gate CMOS device that is pin and function compatible with 74HC04 and 74HCT04.

The 74LV04 provides six inverting buffers.

## 2. Features and benefits

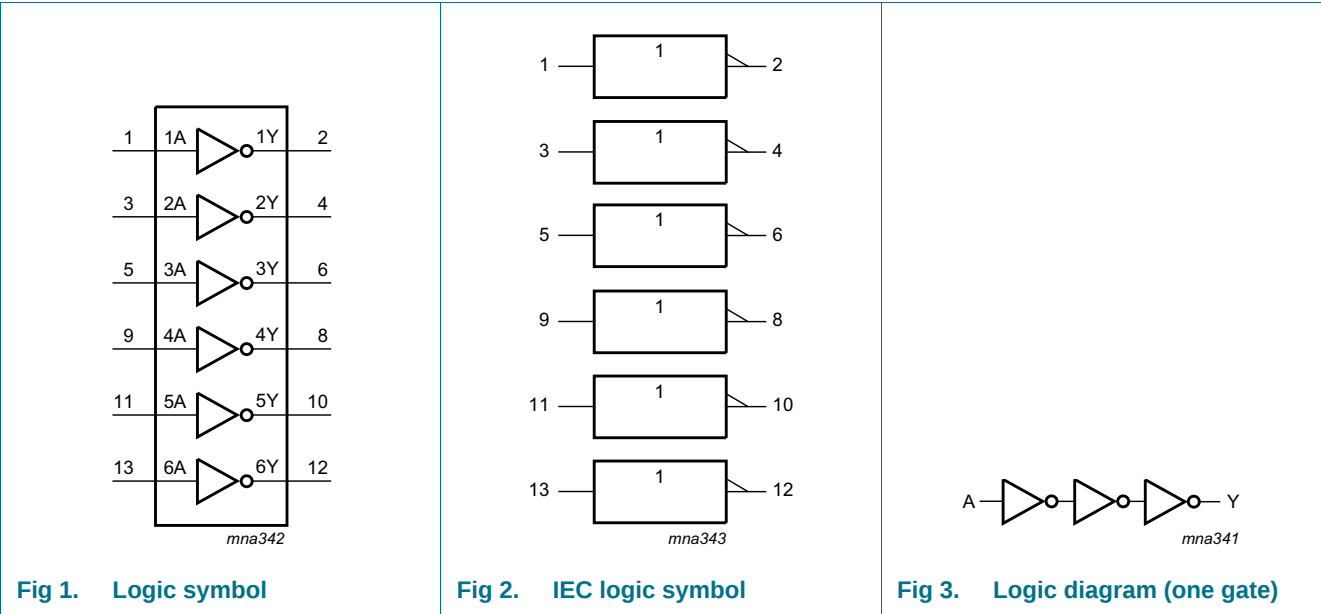
- Wide operating voltage: 1.0 V to 5.5 V
- Optimized for low voltage applications: 1.0 V to 3.6 V
- Accepts TTL input levels between  $V_{CC} = 2.7$  V and  $V_{CC} = 3.6$  V
- Typical output ground bounce  $< 0.8$  V at  $V_{CC} = 3.3$  V and  $T_{amb} = 25$  °C
- Typical HIGH-level output voltage ( $V_{OH}$ ) undershoot:  $> 2$  V at  $V_{CC} = 3.3$  V and  $T_{amb} = 25$  °C
- ESD protection:
  - ◆ HBM JESD22-A114E exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from  $-40$  °C to  $+85$  °C and from  $-40$  °C to  $+125$  °C

## 3. Ordering information

Table 1. Ordering information

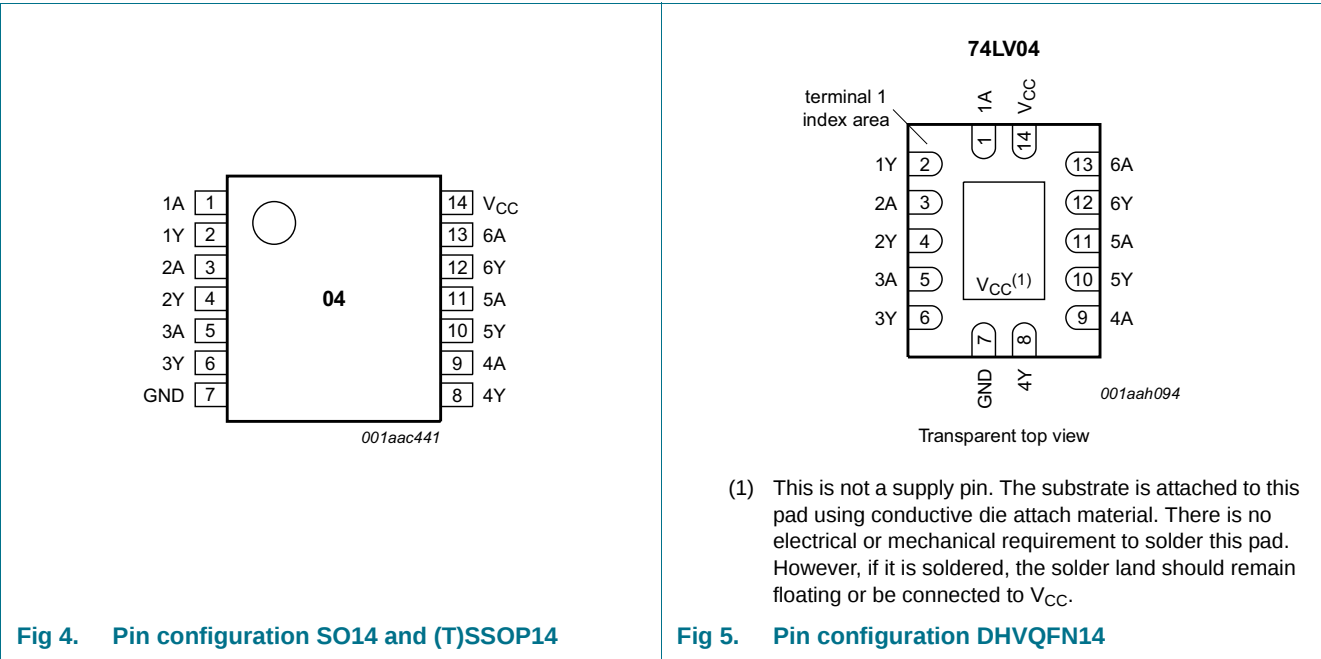
| Type number | Package               |          |                                                                                                                                             |          |
|-------------|-----------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------|----------|
|             | Temperature range     | Name     | Description                                                                                                                                 | Version  |
| 74LV04D     | $-40$ °C to $+125$ °C | SO14     | plastic small outline package; 14 leads;<br>body width 3.9 mm                                                                               | SOT108-1 |
| 74LV04DB    | $-40$ °C to $+125$ °C | SSOP14   | plastic shrink small outline package; 14 leads;<br>body width 5.3 mm                                                                        | SOT337-1 |
| 74LV04PW    | $-40$ °C to $+125$ °C | TSSOP14  | plastic thin shrink small outline package; 14 leads;<br>body width 4.4 mm                                                                   | SOT402-1 |
| 74LV04BQ    | $-40$ °C to $+125$ °C | DHVQFN14 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals;<br>body $2.5 \times 3 \times 0.85$ mm | SOT762-1 |

4. Functional diagram



5. Pinning information

5.1 Pinning



## 5.2 Pin description

**Table 2.** Pin description

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

## 6. Functional description

**Table 3.** Function table

*H = HIGH voltage level; L = LOW voltage level.*

| Input nA | Output nY |
|----------|-----------|
| L        | H         |
| H        | L         |

## 7. Limiting values

**Table 4.** 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 <sub>CC</sub>  | supply voltage          |                                                                                         | −0.5 | +7.0 | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < −0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V <a href="#">[1]</a> | -    | ±20  | mA   |
| I <sub>OK</sub>  | output clamping current | V <sub>O</sub> < −0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V <a href="#">[1]</a> | -    | ±50  | mA   |
| I <sub>O</sub>   | output current          | V <sub>O</sub> = −0.5 V to (V <sub>CC</sub> + 0.5 V)                                    | -    | ±25  | mA   |
| I <sub>CC</sub>  | supply current          |                                                                                         | -    | 50   | mA   |
| I <sub>GND</sub> | ground current          |                                                                                         | −50  | -    | mA   |
| T <sub>stg</sub> | storage temperature     |                                                                                         | −65  | +150 | °C   |

**Table 4.** Limiting values ...continued

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

| Symbol           | Parameter               | Conditions                           | Min | Max | Unit |
|------------------|-------------------------|--------------------------------------|-----|-----|------|
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> = -40 °C to +125 °C |     |     |      |
|                  | SO14 package            | [2]                                  | -   | 500 | mW   |
|                  | (T)SSOP14 package       | [3]                                  | -   | 500 | mW   |
|                  | DHVQFN14 package        | [4]                                  | -   | 500 | mW   |

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] P<sub>tot</sub> derates linearly with 8 mW/K above 70 °C.

[3] P<sub>tot</sub> derates linearly with 5.5 mW/K above 60 °C.

[4] P<sub>tot</sub> derates linearly with 4.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 5.** Recommended operating conditions

Voltages are referenced to GND (ground = 0 V).

| Symbol           | Parameter                           | Conditions                       | Min | Typ | Max             | Unit |
|------------------|-------------------------------------|----------------------------------|-----|-----|-----------------|------|
| V <sub>CC</sub>  | supply voltage                      | [1]                              | 1.0 | 3.3 | 5.5             | V    |
| V <sub>I</sub>   | input voltage                       |                                  | 0   | -   | V <sub>CC</sub> | V    |
| V <sub>O</sub>   | output voltage                      |                                  | 0   | -   | V <sub>CC</sub> | V    |
| T <sub>amb</sub> | ambient temperature                 |                                  | -40 | +25 | +125            | °C   |
| Δt/ΔV            | input transition rise and fall rate | V <sub>CC</sub> = 1.0 V to 2.0 V | -   | -   | 500             | ns/V |
|                  |                                     | V <sub>CC</sub> = 2.0 V to 2.7 V | -   | -   | 200             | ns/V |
|                  |                                     | V <sub>CC</sub> = 2.7 V to 3.6 V | -   | -   | 100             | ns/V |
|                  |                                     | V <sub>CC</sub> = 3.6 V to 5.5 V | -   | -   | 50              | ns/V |

[1] The static characteristics are guaranteed from V<sub>CC</sub> = 1.2 V to V<sub>CC</sub> = 5.5 V, but LV devices are guaranteed to function down to V<sub>CC</sub> = 1.0 V (with input levels GND or V<sub>CC</sub>).

## 9. Static characteristics

**Table 6.** Static characteristics

Voltages are referenced to GND (ground = 0 V).

| Symbol           | Parameter                 | Conditions                                                                                | –40 °C to +85 °C   |                    |                    | –40 °C to +125 °C  |                    | Unit |
|------------------|---------------------------|-------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------|
|                  |                           |                                                                                           | Min                | Typ <sup>[1]</sup> | Max                | Min                | Max                |      |
| V <sub>IH</sub>  | HIGH-level input voltage  | V <sub>CC</sub> = 1.2 V                                                                   | 0.9                | -                  | -                  | 0.9                | -                  | V    |
|                  |                           | V <sub>CC</sub> = 2.0 V                                                                   | 1.4                | -                  | -                  | 1.4                | -                  | V    |
|                  |                           | V <sub>CC</sub> = 2.7 V to 3.6 V                                                          | 2.0                | -                  | -                  | 2.0                | -                  | V    |
|                  |                           | V <sub>CC</sub> = 4.5 V to 5.5 V                                                          | 0.7V <sub>CC</sub> | -                  | -                  | 0.7V <sub>CC</sub> | -                  | V    |
| V <sub>IL</sub>  | LOW-level input voltage   | V <sub>CC</sub> = 1.2 V                                                                   | -                  | -                  | 0.3                | -                  | 0.3                | V    |
|                  |                           | V <sub>CC</sub> = 2.0 V                                                                   | -                  | -                  | 0.6                | -                  | 0.6                | V    |
|                  |                           | V <sub>CC</sub> = 2.7 V to 3.6 V                                                          | -                  | -                  | 0.8                | -                  | 0.8                | V    |
|                  |                           | V <sub>CC</sub> = 4.5 V to 5.5 V                                                          | -                  | -                  | 0.3V <sub>CC</sub> | -                  | 0.3V <sub>CC</sub> | V    |
| V <sub>OH</sub>  | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                       |                    |                    |                    |                    |                    |      |
|                  |                           | I <sub>O</sub> = –100 µA; V <sub>CC</sub> = 1.2 V                                         | -                  | 1.2                | -                  | -                  | -                  | V    |
|                  |                           | I <sub>O</sub> = –100 µA; V <sub>CC</sub> = 2.0 V                                         | 1.8                | 2.0                | -                  | 1.8                | -                  | V    |
|                  |                           | I <sub>O</sub> = –100 µA; V <sub>CC</sub> = 2.7 V                                         | 2.5                | 2.7                | -                  | 2.5                | -                  | V    |
|                  |                           | I <sub>O</sub> = –100 µA; V <sub>CC</sub> = 3.0 V                                         | 2.8                | 3.0                | -                  | 2.8                | -                  | V    |
|                  |                           | I <sub>O</sub> = –100 µA; V <sub>CC</sub> = 4.5 V                                         | 4.3                | 4.5                | -                  | 4.3                | -                  | V    |
|                  |                           | I <sub>O</sub> = –6 mA; V <sub>CC</sub> = 3.0 V                                           | 2.4                | 2.82               | -                  | 2.2                | -                  | V    |
|                  |                           | I <sub>O</sub> = –12 mA; V <sub>CC</sub> = 4.5 V                                          | 3.6                | 4.2                | -                  | 3.5                | -                  | V    |
| V <sub>OL</sub>  | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                       |                    |                    |                    |                    |                    |      |
|                  |                           | I <sub>O</sub> = 100 µA; V <sub>CC</sub> = 1.2 V                                          | -                  | 0                  | -                  | -                  | -                  | V    |
|                  |                           | I <sub>O</sub> = 100 µA; V <sub>CC</sub> = 2.0 V                                          | -                  | 0                  | 0.2                | -                  | 0.2                | V    |
|                  |                           | I <sub>O</sub> = 100 µA; V <sub>CC</sub> = 2.7 V                                          | -                  | 0                  | 0.2                | -                  | 0.2                | V    |
|                  |                           | I <sub>O</sub> = 100 µA; V <sub>CC</sub> = 3.0 V                                          | -                  | 0                  | 0.2                | -                  | 0.2                | V    |
|                  |                           | I <sub>O</sub> = 100 µA; V <sub>CC</sub> = 4.5 V                                          | -                  | 0                  | 0.2                | -                  | 0.2                | V    |
|                  |                           | I <sub>O</sub> = 6 mA; V <sub>CC</sub> = 3.0 V                                            | -                  | 0.25               | 0.40               | -                  | 0.50               | V    |
|                  |                           | I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 4.5 V                                           | -                  | 0.35               | 0.55               | -                  | 0.65               | V    |
| I <sub>I</sub>   | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 5.5 V                       | -                  | -                  | 1.0                | -                  | 1.0                | µA   |
| I <sub>CC</sub>  | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 5.5 V | -                  | -                  | 20.0               | -                  | 40                 | µA   |
| ΔI <sub>CC</sub> | additional supply current | per input; V <sub>I</sub> = V <sub>CC</sub> – 0.6 V;<br>V <sub>CC</sub> = 2.7 V to 3.6 V  | -                  | -                  | 500                | -                  | 850                | µA   |
| C <sub>I</sub>   | input capacitance         |                                                                                           | -                  | 3.5                | -                  | -                  | -                  | pF   |

[1] Typical values are measured at T<sub>amb</sub> = 25 °C.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

$GND = 0\text{ V}$ ; For test circuit see [Figure 7](#).

| Symbol   | Parameter                     | Conditions                                                                 | –40 °C to +85 °C |                    |     | –40 °C to +125 °C |     | Unit |
|----------|-------------------------------|----------------------------------------------------------------------------|------------------|--------------------|-----|-------------------|-----|------|
|          |                               |                                                                            | Min              | Typ <sup>[1]</sup> | Max | Min               | Max |      |
| $t_{pd}$ | propagation delay             | nA to nY; see <a href="#">Figure 6</a>                                     |                  |                    |     |                   |     |      |
|          |                               | $V_{CC} = 1.2\text{ V}$                                                    | -                | 40                 | -   | -                 | -   | ns   |
|          |                               | $V_{CC} = 2.0\text{ V}$                                                    | -                | 14                 | 20  | -                 | 25  | ns   |
|          |                               | $V_{CC} = 2.7\text{ V}$                                                    | -                | 10                 | 15  | -                 | 19  | ns   |
|          |                               | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ ; $C_L = 15\text{ pF}$             | [3]              | 6                  | -   | -                 | -   | ns   |
|          |                               | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$                                    | [3]              | 8                  | 12  | -                 | 15  | ns   |
|          |                               | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$                                    | -                | -                  | 9   | -                 | 11  | ns   |
| $C_{PD}$ | power dissipation capacitance | $C_L = 50\text{ pF}$ ; $f_i = 1\text{ MHz}$ ; $V_i = GND\text{ to }V_{CC}$ | [4]              | 21                 | -   | -                 | -   | pF   |

[1] All typical values are measured at  $T_{amb} = 25\text{ °C}$ .

[2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .

[3] Typical values are measured at nominal supply voltage ( $V_{CC} = 3.3\text{ V}$ ).

[4]  $C_{PD}$  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

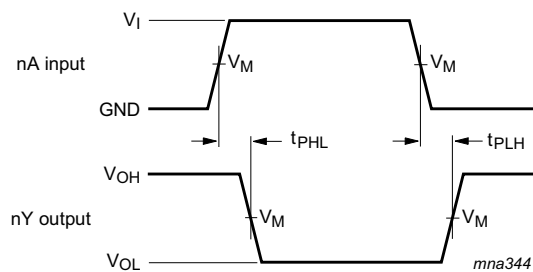
$C_L$  = output load capacitance in pF

$V_{CC}$  = supply voltage in V

$N$  = number of inputs switching

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

11. Waveforms

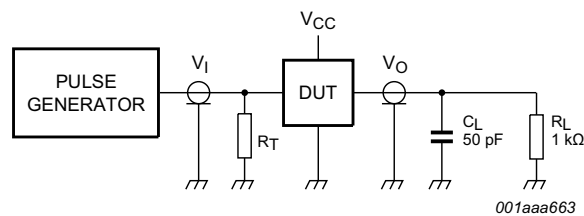


Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

Fig 6. The input (nA) to output (nY) propagation delays

Table 8. Measurement points

| Supply voltage                  | Input          | Output         |
|---------------------------------|----------------|----------------|
| $V_{CC}$                        | $V_M$          | $V_M$          |
| $< 2.7\text{ V}$                | $0.5V_{CC}$    | $0.5V_{CC}$    |
| $2.7\text{ V to } 3.6\text{ V}$ | $1.5\text{ V}$ | $1.5\text{ V}$ |
| $\geq 4.5\text{ V}$             | $0.5V_{CC}$    | $0.5V_{CC}$    |



Test data is given in [Table 9](#).  
Definitions test circuit:  
 $R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.  
 $R_L$  = Load resistance.  
 $C_L$  = Load capacitance including jig and probe capacitance.

Fig 7. Test circuit for measuring switching times

Table 9. Test data

| Supply voltage                  | Input          |                      |
|---------------------------------|----------------|----------------------|
| $V_{CC}$                        | $V_I$          | $t_r, t_f$           |
| $< 2.7\text{ V}$                | $V_{CC}$       | $\leq 2.5\text{ ns}$ |
| $2.7\text{ V to } 3.6\text{ V}$ | $2.7\text{ V}$ | $\leq 2.5\text{ ns}$ |
| $\geq 4.5\text{ V}$             | $V_{CC}$       | $\leq 2.5\text{ ns}$ |

12. Package outline

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

SOT108-1

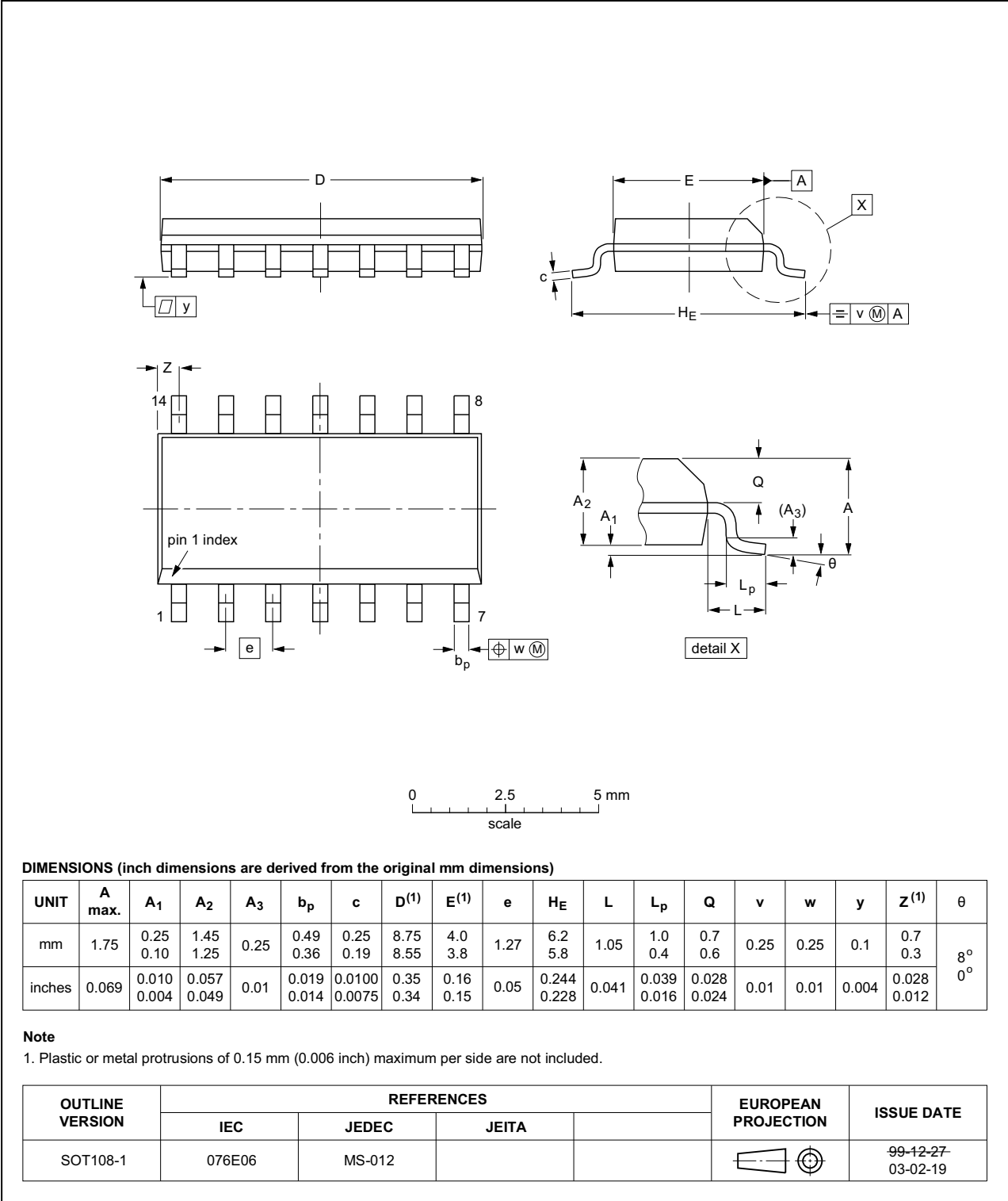


Fig 8. Package outline SOT108-1 (SO14)

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

SOT337-1

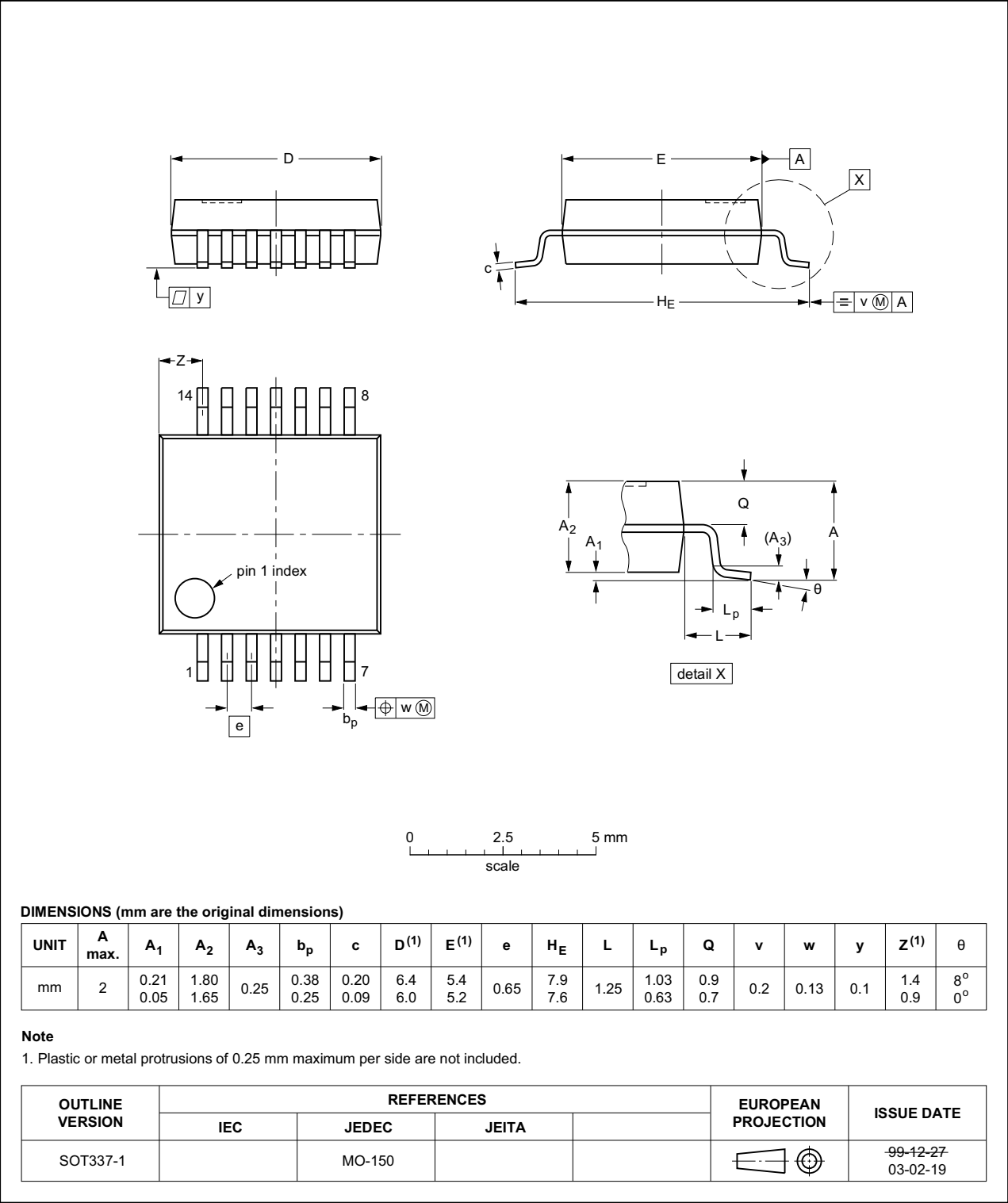
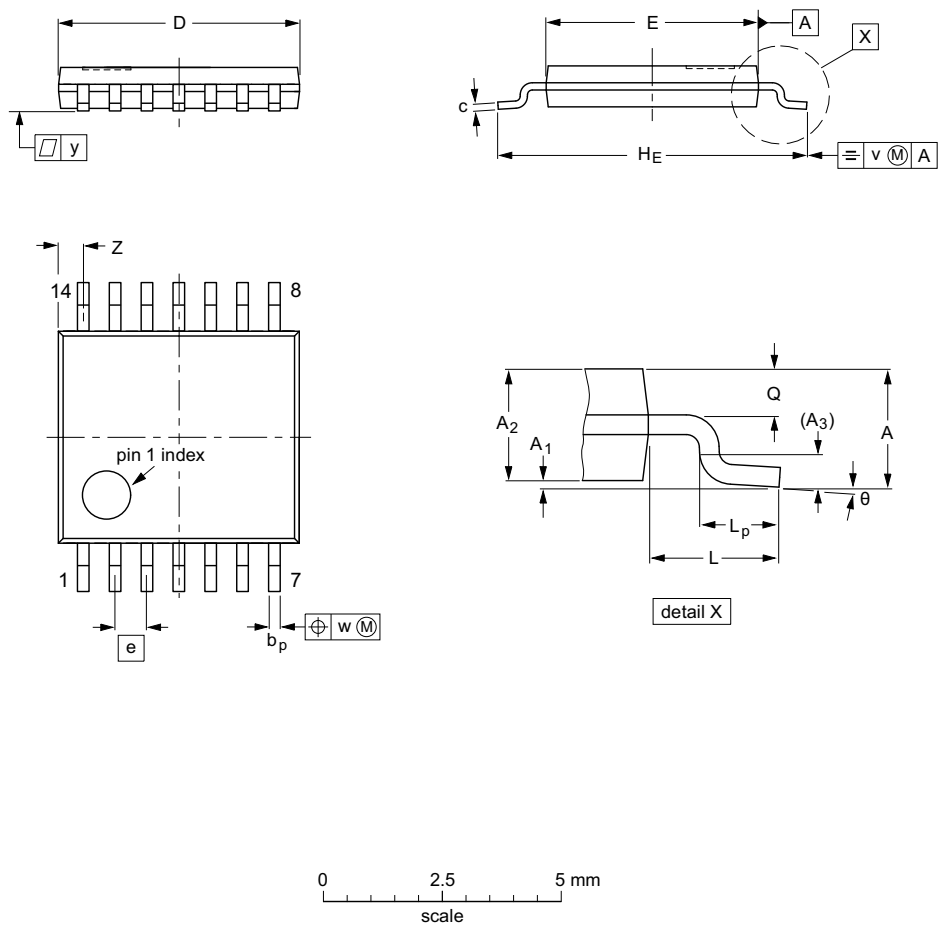


Fig 9. Package outline SOT337-1 (SSOP14)

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

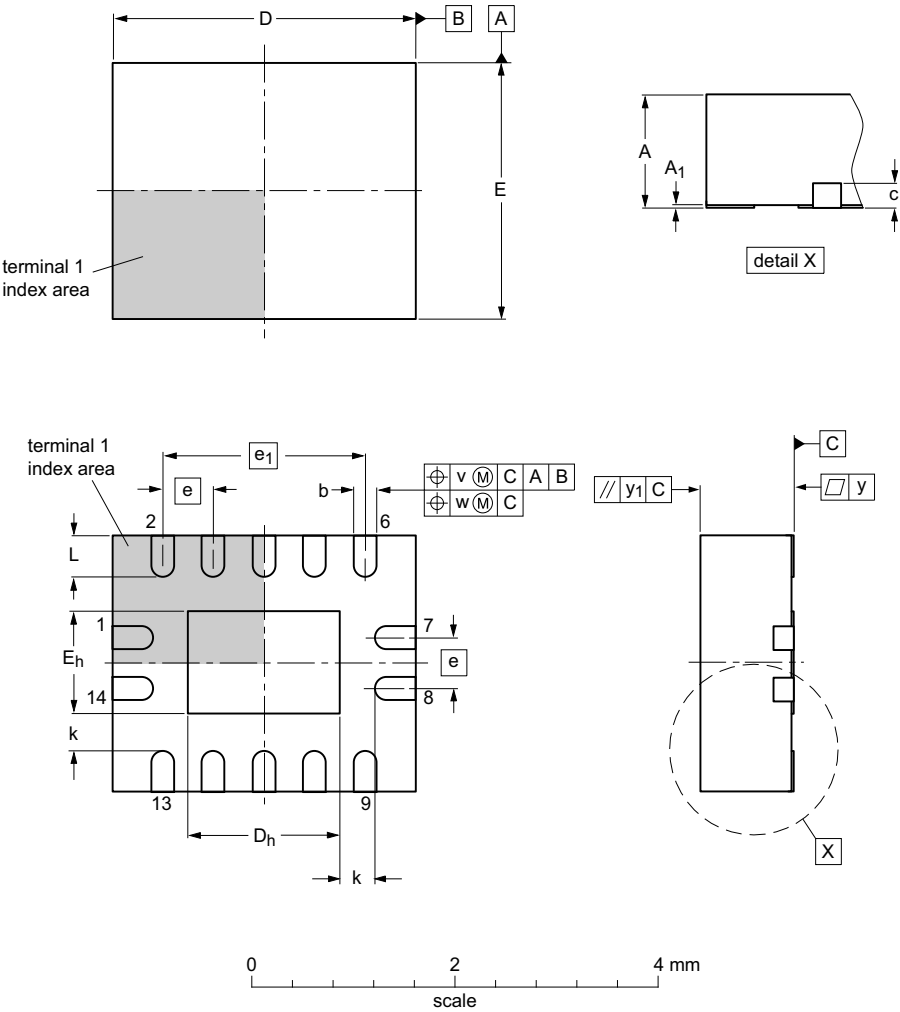
- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

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

Fig 10. Package outline SOT402-1 (TSSOP14)

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> | 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> | k   | L   | v   | w    | y    | y <sub>1</sub> |
|------|------------------|----------------|------|------|------------------|----------------|------------------|----------------|-----|----------------|-----|-----|-----|------|------|----------------|
| mm   | max              | 1              | 0.05 | 0.30 | 3.1              | 1.65           | 2.6              | 1.15           |     |                |     | 0.5 |     |      |      |                |
|      | nom              |                | 0.02 | 0.25 | 3.0              | 1.50           | 2.5              | 1.00           | 0.5 | 2              |     | 0.4 | 0.1 | 0.05 | 0.05 | 0.1            |
|      | min              |                | 0.00 | 0.18 | 2.9              | 1.35           | 2.4              | 0.85           |     |                | 0.2 | 0.3 |     |      |      |                |

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

sot762-1\_po

| Outline version | References |        |       |  | European projection | Issue date            |
|-----------------|------------|--------|-------|--|---------------------|-----------------------|
|                 | IEC        | JEDEC  | JEITA |  |                     |                       |
| SOT762-1        |            | MO-241 |       |  |                     | 15-04-10-<br>15-05-05 |

Fig 11. Package outline SOT762-1 (DHVQFN14)

## 13. Abbreviations

Table 10. Abbreviations

| Acronym | Description                             |
|---------|-----------------------------------------|
| CMOS    | Complementary Metal Oxide Semiconductor |
| DUT     | Device Under Test                       |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |
| MM      | Machine Model                           |
| TTL     | Transistor-Transistor Logic             |

## 14. Revision history

Table 11. Revision history

| Document ID    | Release date                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Data sheet status     | Change notice | Supersedes |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|------------|
| 74LV04 v.4     | 20151208                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Product data sheet    | -             | 74LV04 v.3 |
| Modifications: | <ul style="list-style-type: none"><li>Type number 74LV04N (SOT27-1) removed.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                        |                       |               |            |
| 74LV04 v.3     | 20071204                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Product data sheet    | -             | 74LV04 v.2 |
| Modifications: | <ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors</li><li>Legal texts have been adapted to the new company name where appropriate.</li><li><a href="#">Section 3</a>: DHVQFN14 package added.</li><li><a href="#">Section 8</a>: derating values added for DHVQFN14 package.</li><li><a href="#">Section 12</a>: outline drawing added for DHVQFN14 package.</li></ul> |                       |               |            |
| 74LV04 v.2     | 19980420                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Product specification | -             | 74LV04 v.1 |
| 74LV04 v.1     | 19970203                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Product specification | -             | -          |

## 15. Legal information

### 15.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition                                                                            |
|-----------------------------------|-------------------------------|---------------------------------------------------------------------------------------|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet    | Qualification                 | This document contains data from the preliminary specification.                       |
| Product [short] data sheet        | Production                    | This document contains the product specification.                                     |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nexperia.com>.

### 15.2 Definitions

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For more information, please visit: <http://www.nexperia.com>

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