

# HEF4049B

## Hex inverting buffers

Rev. 11 — 23 June 2016

Product data sheet

### 1. General description

The HEF4049B provides six inverting buffers with high current output capability suitable for driving TTL or high capacitive loads. Since input voltages in excess of the buffers' supply voltage are permitted, the buffers may also be used to convert logic levels of up to 15 V to standard TTL levels. Their guaranteed fan-out into common bipolar logic elements is shown in [Table 3](#).

It operates over a recommended  $V_{DD}$  power supply range of 3 V to 15 V referenced to  $V_{SS}$  (usually ground). Unused inputs must be connected to  $V_{DD}$ ,  $V_{SS}$ , or another input.

### 2. Features and benefits

- Accepts input voltages in excess of the supply voltage
- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$
- Complies with JEDEC standard JESD 13-B

### 3. Applications

- LOCMOS (Local Oxidation CMOS) to DTL/TTL converter
- HIGH sink current for driving two TTL loads
- HIGH-to-LOW level logic conversion

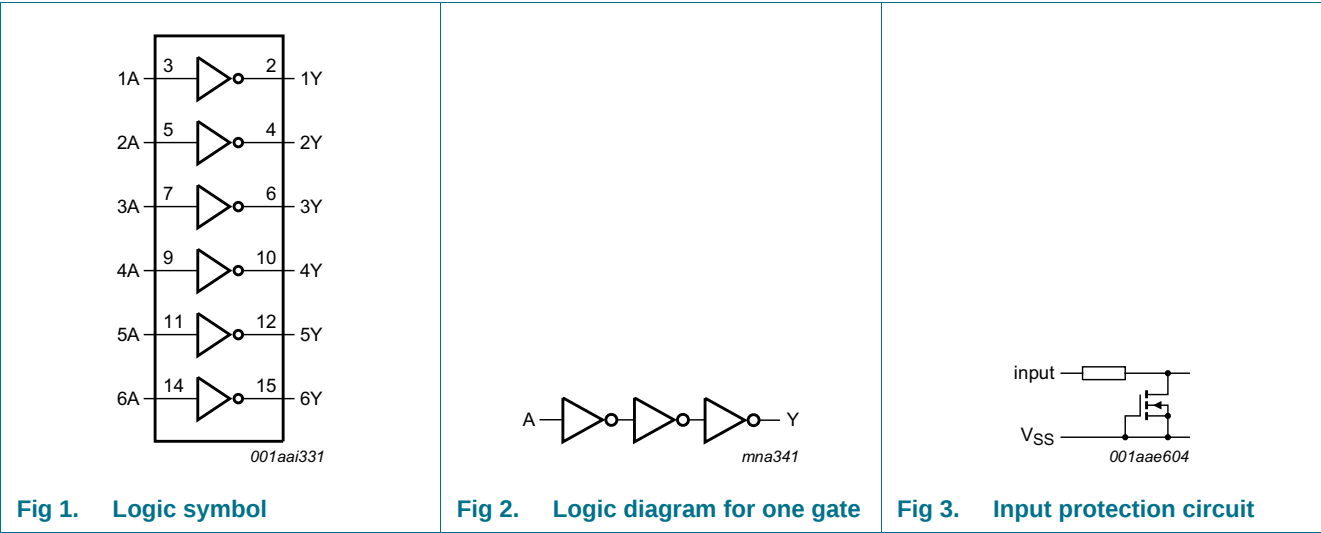
### 4. Ordering information

**Table 1.** Ordering information

All types operate from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$ .

| Type number | Package |                                                            |          |
|-------------|---------|------------------------------------------------------------|----------|
|             | Name    | Description                                                | Version  |
| HEF4049BT   | SO16    | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |

5. Functional diagram



6. Pinning information

6.1 Pinning

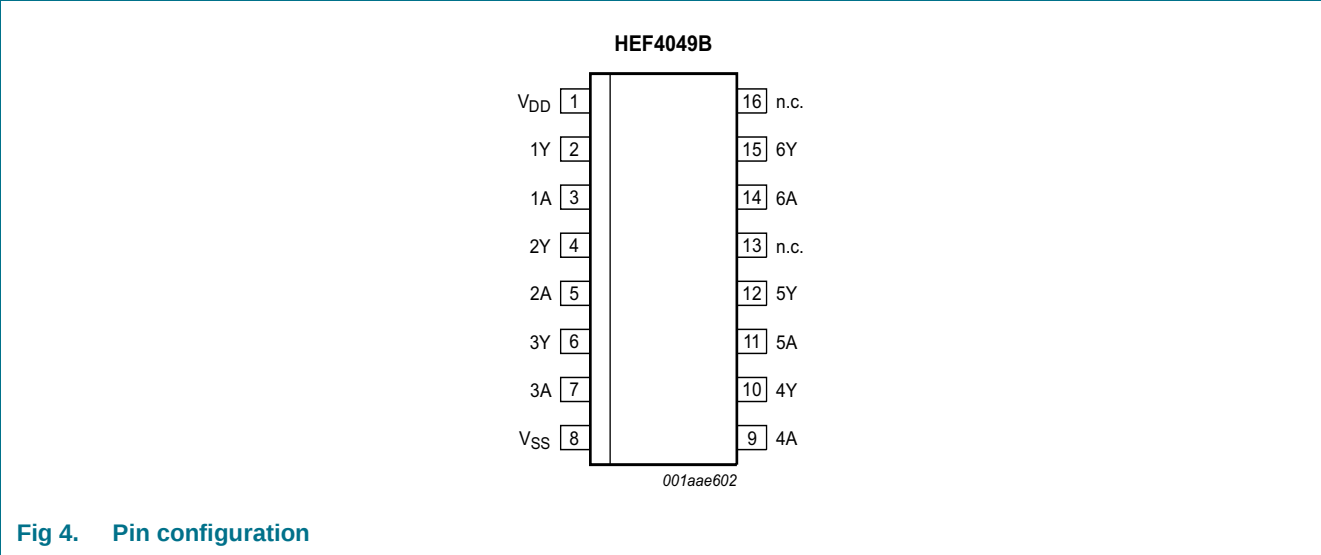


Fig 4. Pin configuration

6.2 Pin description

Table 2. Pin description

| Symbol          | Pin                 | Description           |
|-----------------|---------------------|-----------------------|
| V <sub>DD</sub> | 1                   | supply voltage        |
| 1Y to 6Y        | 2, 4, 6, 10, 12, 15 | output                |
| 1A to 6A        | 3, 5, 7, 9, 11, 14  | input                 |
| V <sub>SS</sub> | 8                   | ground supply voltage |
| n.c.            | 13, 16              | not connected         |

7. Functional description

Table 3. Guaranteed fan-out

| Driven element | Guaranteed fan-out |
|----------------|--------------------|
| Standard TTL   | 2                  |
| 74 LS          | 9                  |
| 74 L           | 16                 |

## 8. Limiting values

**Table 4. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol    | Parameter               | Conditions                               | Min  | Max      | Unit |
|-----------|-------------------------|------------------------------------------|------|----------|------|
| $V_{DD}$  | supply voltage          |                                          | -0.5 | +18      | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5$ V                           | -10  | -        | mA   |
| $V_I$     | input voltage           |                                          | -0.5 | +18      | V    |
| $I_{OK}$  | output clamping current | $V_O < -0.5$ V or $V_O > V_{DD} + 0.5$ V | -    | $\pm 10$ | mA   |
| $I_{I/O}$ | input/output current    |                                          | -    | $\pm 10$ | mA   |
| $I_{DD}$  | supply current          |                                          | -    | 50       | mA   |
| $T_{stg}$ | storage temperature     |                                          | -65  | +150     | °C   |
| $T_{amb}$ | ambient temperature     |                                          | -40  | +85      | °C   |
| $P_{tot}$ | total power dissipation | $T_{amb} -40$ °C to +85 °C               |      |          |      |
|           |                         | SO16 package <a href="#">[1]</a>         | -    | 500      | mW   |
| $P$       | power dissipation       | per output                               | -    | 100      | mW   |

[1] For SO16 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

## 9. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol              | Parameter                           | Conditions      | Min | Typ | Max  | Unit            |
|---------------------|-------------------------------------|-----------------|-----|-----|------|-----------------|
| $V_{DD}$            | supply voltage                      |                 | 3   | -   | 15   | V               |
| $V_I$               | input voltage                       |                 | 0   | -   | 15   | V               |
| $T_{amb}$           | ambient temperature                 | in free air     | -40 | -   | +85  | °C              |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{DD} = 5$ V  | -   | -   | 3.75 | $\mu\text{s/V}$ |
|                     |                                     | $V_{DD} = 10$ V | -   | -   | 0.5  | $\mu\text{s/V}$ |
|                     |                                     | $V_{DD} = 15$ V | -   | -   | 0.08 | $\mu\text{s/V}$ |

## 10. Static characteristics

**Table 6. Static characteristics**

$V_{SS} = 0$  V;  $V_I = V_{SS}$  or  $V_{DD}$  unless otherwise specified.

| Symbol   | Parameter                | Conditions                | $V_{DD}$ | $T_{amb} = -40$ °C |     | $T_{amb} = 25$ °C |     | $T_{amb} = 85$ °C |     | Unit |
|----------|--------------------------|---------------------------|----------|--------------------|-----|-------------------|-----|-------------------|-----|------|
|          |                          |                           |          | Min                | Max | Min               | Max | Min               | Max |      |
| $V_{IH}$ | HIGH-level input voltage | $ I_O  < 1$ $\mu\text{A}$ | 5 V      | 3.5                | -   | 3.5               | -   | 3.5               | -   | V    |
|          |                          |                           | 10 V     | 7.0                | -   | 7.0               | -   | 7.0               | -   | V    |
|          |                          |                           | 15 V     | 11.0               | -   | 11.0              | -   | 11.0              | -   | V    |
| $V_{IL}$ | LOW-level input voltage  | $ I_O  < 1$ $\mu\text{A}$ | 5 V      | -                  | 1.5 | -                 | 1.5 | -                 | 1.5 | V    |
|          |                          |                           | 10 V     | -                  | 3.0 | -                 | 3.0 | -                 | 3.0 | V    |
|          |                          |                           | 15 V     | -                  | 4.0 | -                 | 4.0 | -                 | 4.0 | V    |

**Table 6.** Static characteristics ...continued $V_{SS} = 0\text{ V}$ ;  $V_I = V_{SS}$  or  $V_{DD}$  unless otherwise specified.

| Symbol   | Parameter                 | Conditions                     | $V_{DD}$ | $T_{amb} = -40\text{ °C}$ |           | $T_{amb} = 25\text{ °C}$ |           | $T_{amb} = 85\text{ °C}$ |           | Unit          |
|----------|---------------------------|--------------------------------|----------|---------------------------|-----------|--------------------------|-----------|--------------------------|-----------|---------------|
|          |                           |                                |          | Min                       | Max       | Min                      | Max       | Min                      | Max       |               |
| $V_{OH}$ | HIGH-level output voltage | $ I_O  < 1\text{ }\mu\text{A}$ | 5 V      | 4.95                      | -         | 4.95                     | -         | 4.95                     | -         | V             |
|          |                           |                                | 10 V     | 9.95                      | -         | 9.95                     | -         | 9.95                     | -         | V             |
|          |                           |                                | 15 V     | 14.95                     | -         | 14.95                    | -         | 14.95                    | -         | V             |
| $V_{OL}$ | LOW-level output voltage  | $ I_O  < 1\text{ }\mu\text{A}$ | 5 V      | -                         | 0.05      | -                        | 0.05      | -                        | 0.05      | V             |
|          |                           |                                | 10 V     | -                         | 0.05      | -                        | 0.05      | -                        | 0.05      | V             |
|          |                           |                                | 15 V     | -                         | 0.05      | -                        | 0.05      | -                        | 0.05      | V             |
| $I_{OH}$ | HIGH-level output current | $V_O = 2.5\text{ V}$           | 5 V      | -                         | -1.7      | -                        | -1.4      | -                        | -1.1      | mA            |
|          |                           | $V_O = 4.6\text{ V}$           | 5 V      | -                         | -0.52     | -                        | -0.44     | -                        | -0.36     | mA            |
|          |                           | $V_O = 9.5\text{ V}$           | 10 V     | -                         | -1.3      | -                        | -1.1      | -                        | -0.9      | mA            |
|          |                           | $V_O = 13.5\text{ V}$          | 15 V     | -                         | -3.6      | -                        | -3.0      | -                        | -2.4      | mA            |
| $I_{OL}$ | LOW-level output current  | $V_O = 0.4\text{ V}$           | 4.75 V   | 3.5                       | -         | 2.9                      | -         | 2.3                      | -         | mA            |
|          |                           | $V_O = 0.5\text{ V}$           | 10 V     | 12.0                      | -         | 10.0                     | -         | 8.0                      | -         | mA            |
|          |                           | $V_O = 1.5\text{ V}$           | 15 V     | 24.0                      | -         | 20.0                     | -         | 16.0                     | -         | mA            |
| $I_I$    | input leakage current     | $V_{DD} = 15\text{ V}$         | 15 V     | -                         | $\pm 0.3$ | -                        | $\pm 0.3$ | -                        | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{DD}$ | supply current            | $I_O = 0\text{ A}$             | 5 V      | -                         | 4.0       | -                        | 4.0       | -                        | 30        | $\mu\text{A}$ |
|          |                           |                                | 10 V     | -                         | 8.0       | -                        | 8.0       | -                        | 60        | $\mu\text{A}$ |
|          |                           |                                | 15 V     | -                         | 16.0      | -                        | 16.0      | -                        | 120       | $\mu\text{A}$ |
| $C_I$    | input capacitance         |                                |          | -                         | -         | -                        | 7.5       | -                        | -         | pF            |

## 11. Dynamic characteristics

**Table 7.** Dynamic characteristics $V_{SS} = 0\text{ V}$ ;  $C_L = 50\text{ pF}$ ;  $t_r = t_f \leq 20\text{ ns}$ ;  $T_{amb} = 25\text{ °C}$ ; unless otherwise specified.

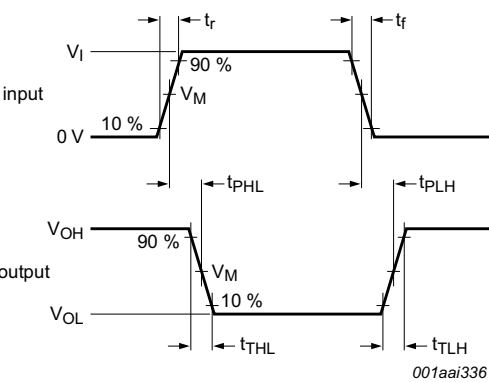
| Symbol    | Parameter                          | Conditions                                | $V_{DD}$                | Extrapolation formula                   | Min | Typ | Max | Unit |
|-----------|------------------------------------|-------------------------------------------|-------------------------|-----------------------------------------|-----|-----|-----|------|
| $t_{PHL}$ | HIGH to LOW propagation delay      | nA to nY;<br>see <a href="#">Figure 5</a> | 5 V <a href="#">[1]</a> | $26\text{ ns} + (0.18\text{ ns/pF})C_L$ | -   | 35  | 70  | ns   |
|           |                                    |                                           | 10 V                    | $11\text{ ns} + (0.08\text{ ns/pF})C_L$ | -   | 15  | 30  | ns   |
|           |                                    |                                           | 15 V                    | $9\text{ ns} + (0.05\text{ ns/pF})C_L$  | -   | 12  | 25  | ns   |
| $t_{PLH}$ | LOW to HIGH propagation delay      | nA to nY;<br>see <a href="#">Figure 5</a> | 5 V <a href="#">[1]</a> | $23\text{ ns} + (0.55\text{ ns/pF})C_L$ | -   | 50  | 100 | ns   |
|           |                                    |                                           | 10 V                    | $14\text{ ns} + (0.23\text{ ns/pF})C_L$ | -   | 25  | 50  | ns   |
|           |                                    |                                           | 15 V                    | $12\text{ ns} + (0.16\text{ ns/pF})C_L$ | -   | 20  | 40  | ns   |
| $t_{THL}$ | HIGH to LOW output transition time | see <a href="#">Figure 5</a>              | 5 V <a href="#">[1]</a> | $3\text{ ns} + (0.35\text{ ns/pF})C_L$  | -   | 20  | 40  | ns   |
|           |                                    |                                           | 10 V                    | $3\text{ ns} + (0.14\text{ ns/pF})C_L$  | -   | 10  | 20  | ns   |
|           |                                    |                                           | 15 V                    | $2\text{ ns} + (0.09\text{ ns/pF})C_L$  | -   | 7   | 14  | ns   |
| $t_{TLH}$ | LOW to HIGH output transition time | see <a href="#">Figure 5</a>              | 5 V <a href="#">[1]</a> | $10\text{ ns} + (1.00\text{ ns/pF})C_L$ | -   | 60  | 120 | ns   |
|           |                                    |                                           | 10 V                    | $9\text{ ns} + (0.42\text{ ns/pF})C_L$  | -   | 30  | 60  | ns   |
|           |                                    |                                           | 15 V                    | $6\text{ ns} + (0.28\text{ ns/pF})C_L$  | -   | 20  | 40  | ns   |

[1] The typical values of the propagation delay and transition times are calculated from the extrapolation formulas shown ( $C_L$  in pF).

**Table 8. Dynamic power dissipation  $P_D$**   
 $P_D$  can be calculated from the formulas shown.  $V_{SS} = 0\text{ V}$ ;  $t_r = t_f \leq 20\text{ ns}$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ .

| Symbol | Parameter                 | $V_{DD}$ | Typical formula for $P_D$ ( $\mu\text{W}$ )                       | where:                                                                                                                                                                                             |
|--------|---------------------------|----------|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $P_D$  | dynamic power dissipation | 5 V      | $P_D = 2500 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$  | $f_i$ = input frequency in MHz;<br>$f_o$ = output frequency in MHz;<br>$C_L$ = output load capacitance in pF;<br>$V_{DD}$ = supply voltage in V;<br>$\Sigma(f_o \times C_L)$ = sum of the outputs. |
|        |                           | 10 V     | $P_D = 11000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ |                                                                                                                                                                                                    |
|        |                           | 15 V     | $P_D = 35000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ |                                                                                                                                                                                                    |

12. Waveforms

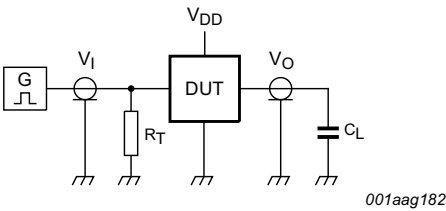


Measurement points are given in [Table 9](#).  
 $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 5. Input (nA) to output (nY) propagation delays and transition times**

**Table 9. Measurement points**

| Input       |                 | Output      |             |             |
|-------------|-----------------|-------------|-------------|-------------|
| $V_M$       | $V_I$           | $V_M$       | $V_X$       | $V_Y$       |
| $0.5V_{DD}$ | 0 V to $V_{DD}$ | $0.5V_{DD}$ | $0.1V_{DD}$ | $0.9V_{DD}$ |



Test data is given in [Table 10](#).

Definitions for test circuit:

$C_L$  = Load capacitance including jig and probe capacitance.

$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

**Fig 6. Test circuit for measuring switching times**

**Table 10. Test data**

| Supply voltage | Input    |          |                      | Load  |
|----------------|----------|----------|----------------------|-------|
| $V_{DD}$       | $V_I$    | $V_M$    | $t_r, t_f$           | $C_L$ |
| 5 V to 15 V    | $V_{DD}$ | $0.5V_I$ | $\leq 20 \text{ ns}$ | 50 pF |

13. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1

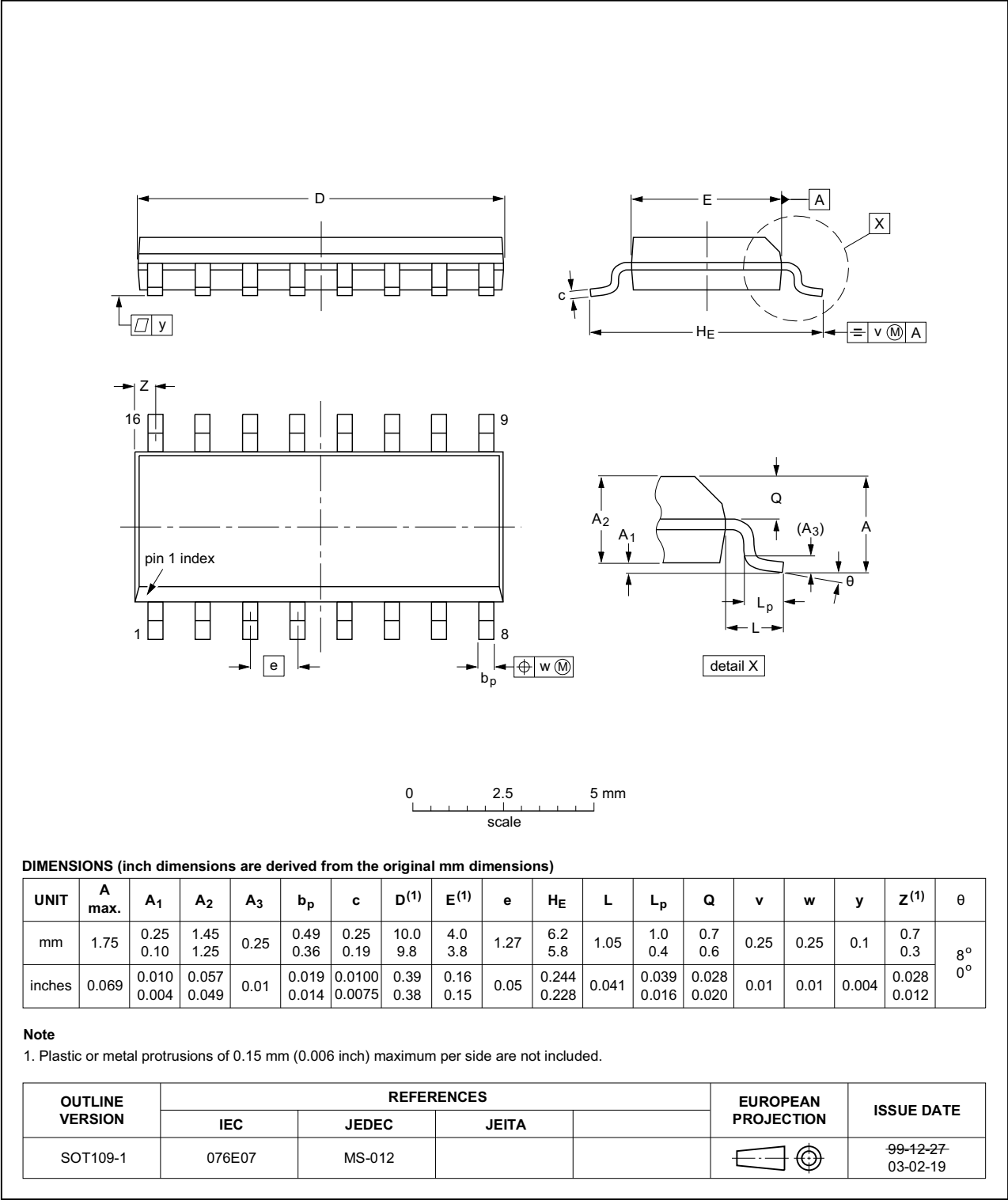


Fig 7. Package outline SOT109-1 (SO16)

## 14. Abbreviations

Table 11. Abbreviations

| Acronym | Description                 |
|---------|-----------------------------|
| DTL     | Diode Transistor Logic      |
| DUT     | Device Under Test           |
| LOC MOS | Local Oxidation CMOS        |
| TTL     | Transistor-Transistor Logic |

## 15. Revision history

Table 12. Revision history

| Document ID      | Release date                                                                                                                                                                                                                          | Data sheet status     | Change notice | Supersedes       |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|------------------|
| HEF4049B v.11    | 20160623                                                                                                                                                                                                                              | Product data sheet    | -             | HEF4049B v.10    |
| Modifications:   | <ul style="list-style-type: none"> <li><a href="#">Table 4</a>: condition for input clamping current changed (typo corrected).</li> <li><a href="#">Table 5</a>: maximum value for input voltage changed (typo corrected).</li> </ul> |                       |               |                  |
| HEF4049B v.10    | 20160324                                                                                                                                                                                                                              | Product data sheet    | -             | HEF4049B v.9     |
| Modifications:   | <ul style="list-style-type: none"> <li>Type number HEF4049BP (SOT38-4) removed.</li> </ul>                                                                                                                                            |                       |               |                  |
| HEF4049B v.9     | 20111118                                                                                                                                                                                                                              | Product data sheet    | -             | HEF4049B v.8     |
| Modifications:   | <ul style="list-style-type: none"> <li><a href="#">Table 6</a>: <math>I_{OH}</math> minimum values changed to maximum</li> <li><a href="#">Table 11</a>: Added DUT</li> </ul>                                                         |                       |               |                  |
| HEF4049B v.8     | 20091202                                                                                                                                                                                                                              | Product data sheet    | -             | HEF4049B v.7     |
| HEF4049B v.7     | 20090721                                                                                                                                                                                                                              | Product data sheet    | -             | HEF4049B v.6     |
| HEF4049B v.6     | 20090325                                                                                                                                                                                                                              | Product data sheet    | -             | HEF4049B v.5     |
| HEF4049B v.5     | 20081111                                                                                                                                                                                                                              | Product data sheet    | -             | HEF4049B v.4     |
| HEF4049B v.4     | 20080704                                                                                                                                                                                                                              | Product data sheet    | -             | HEF4049B_CNV v.3 |
| HEF4049B_CNV v.3 | 19950101                                                                                                                                                                                                                              | Product specification | -             | HEF4049B_CNV v.2 |
| HEF4049B_CNV v.2 | 19950101                                                                                                                                                                                                                              | Product specification | -             | -                |

## 16. Legal information

### 16.1 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".

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Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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