# HEF4043B

## Quad R/S latch with 3-state outputs

Rev. 09 — 16 December 2009 Product data sheet

## 1. General description

The HEF4043B is a quad R/S latch with 3-state outputs with a common output enable input (OE). Each latch has an active HIGH set input (1S to 4S), an active HIGH reset input (1R to 4R) and an active HIGH 3-state output (1Q to 4Q).

When OE is HIGH, the latch output (nQ) is determined by the nR and nS inputs as shown in Table 3. When OE is LOW, the latch outputs are in the high impedance OFF-state. OE does not affect the state of the latch. The high impedance off-state feature allows common bussing of the outputs.

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. It is also suitable for use over the industrial (−40 °C to +85 °C) temperature range.

## 2. Features

- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Operates across the full industrial temperature range −40 °C to +85 °C
- Complies with JEDEC standard JESD 13-B

## 3. Applications

- Four-bit storage with output enable

## 4. Ordering information

**Table 1. Ordering information**

*All types operate from −40 °C to +85 °C.*

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| HEF4043BP | DIP16 | plastic dual in-line package; 16 leads (300 mil) | SOT38-4 |
| HEF4043BT | SO16 | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |

## 5. Functional diagram

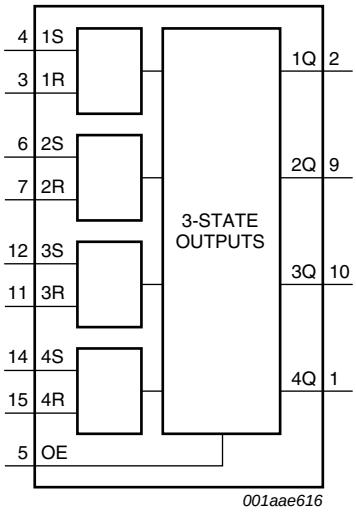



Fig 1. Functional diagram

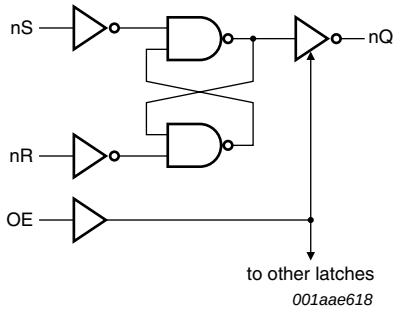



Fig 2. Logic diagram for one latch

## 6. Pinning information

### 6.1 Pinning

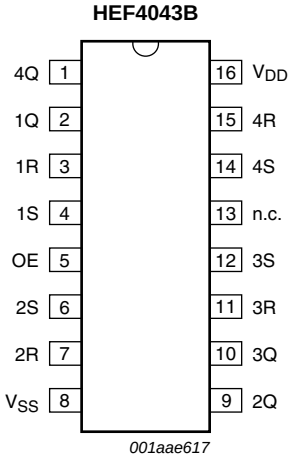



Fig 3. Pin configuration

### 6.2 Pin description

**Table 2. Pin description**

| Symbol | Pin | Description |
|---|---|---|
| 1Q to 4Q | 2, 9, 10, 1 | 3-state buffered latch output |
| 1R to 4R | 3, 7, 11, 15 | reset input (active HIGH) |
| 1S to 4S | 4, 6, 12, 14 | set input (active HIGH) |
| OE | 5 | common output enable input |
| $V_{SS}$ | 8 | ground supply voltage |
| n.c. | 13 | not connected |
| $V_{DD}$ | 16 | supply voltage |

## 7. Functional description

**Table 3. Function table[1]**

| Inputs | | | Output |
|---|---|---|---|
| OE | nS | nR | nQ |
| L | X | X | Z |
| H | L | H | L |
| H | H | X | H |
| H | L | L | latched |

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high impedance state.

## 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 or $V_I > V_{DD} + 0.5$ V | | - | ±10 | mA |
| $V_I$ | input voltage | | | −0.5 | $V_{DD} + 0.5$ | V |
| $I_{OK}$ | output clamping current | $V_O < -0.5$ V or $V_O > V_{DD} + 0.5$ V | | - | ±10 | mA |
| $I_{I/O}$ | input/output current | | | - | ±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 | | | | |
| | | DIP16 package | [1] | - | 750 | mW |
| | | SO16 package | [2] | - | 500 | mW |
| P | power dissipation | per output | | - | 100 | mW |

[1] For DIP16 package: $P_{tot}$ derates linearly with 12 mW/K above 70 °C.

[2] 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 | - | $V_{DD}$ | 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 | μs/V |
| | | $V_{DD}$ = 10 V | - | - | 0.5 | μs/V |
| | | $V_{DD}$ = 15 V | - | - | 0.08 | μs/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 μA | 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 μA | 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 |
| $V_{OH}$ | HIGH-level output voltage | $\|I_O\|$ < 1 μA | 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 μA | 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 V | 5 V | −1.7 | - | −1.4 | - | −1.1 | - | mA |
| | | $V_O$ = 4.6 V | 5 V | −0.52 | - | −0.44 | - | −0.36 | - | mA |
| | | $V_O$ = 9.5 V | 10 V | −1.3 | - | −1.1 | - | −0.9 | - | mA |
| | | $V_O$ = 13.5 V | 15 V | −3.6 | - | −3.0 | - | −2.4 | - | mA |
| $I_{OL}$ | LOW-level output current | $V_O$ = 0.4 V | 5 V | 0.52 | - | 0.44 | - | 0.36 | - | mA |
| | | $V_O$ = 0.5 V | 10 V | 1.3 | - | 1.1 | - | 0.9 | - | mA |
| | | $V_O$ = 1.5 V | 15 V | 3.6 | - | 3.0 | - | 2.4 | - | mA |
| $I_I$ | input leakage current | | 15 V | - | ±0.3 | - | ±0.3 | - | ±1.0 | μA |
| $I_{OZ}$ | OFF-state output current | nQ output HIGH; returned to $V_{DD}$ | 15 V | - | 1.6 | - | 1.6 | - | 12.0 | μA |
| | | nQ output LOW; returned to $V_{SS}$ | 15 V | - | 1.6 | - | 1.6 | - | 12.0 | μA |

**Table 6. Static characteristics** *...continued*

*$V_{SS}$ = 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 | |
| $I_{DD}$ | supply current | $I_O$ = 0 A | 5 V | - | 20 | - | 20 | - | 150 | μA |
| | | | 10 V | - | 40 | - | 40 | - | 300 | μA |
| | | | 15 V | - | 80 | - | 80 | - | 600 | μA |
| $C_I$ | input capacitance | | | - | - | - | 7.5 | - | - | pF |

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

*$V_{SS}$ = 0 V; $T_{amb}$ = 25 °C; For waveforms and test circuit see Section 12; unless otherwise specified.*

| Symbol | Parameter | Conditions | $V_{DD}$ | | Extrapolation formula | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|
| $t_{PHL}$ | HIGH to LOW propagation delay | nR → nQ; see Figure 4 | 5 V | [1] | 63 ns + (0.55 ns/pF)$C_L$ | - | 90 | 180 | ns |
| | | | 10 V | | 24 ns + (0.23 ns/pF)$C_L$ | - | 35 | 70 | ns |
| | | | 15 V | | 17 ns + (0.16 ns/pF)$C_L$ | - | 25 | 50 | ns |
| $t_{PLH}$ | LOW to HIGH propagation delay | nS → nQ; see Figure 4 | 5 V | [1] | 38 ns + (0.55 ns/pF)$C_L$ | - | 65 | 135 | ns |
| | | | 10 V | | 14 ns + (0.23 ns/pF)$C_L$ | - | 25 | 50 | ns |
| | | | 15 V | | 7 ns + (0.16 ns/pF)$C_L$ | - | 15 | 35 | ns |
| $t_t$ | transition time | nQ output; see Figure 4 | 5 V | [1] [2] | 10 ns + (1.00 ns/pF)$C_L$ | - | 60 | 120 | ns |
| | | | 10 V | | 9 ns + (0.42 ns/pF)$C_L$ | - | 30 | 60 | ns |
| | | | 15 V | | 6 ns + (0.28 ns/pF)$C_L$ | - | 20 | 40 | ns |
| $t_{PHZ}$ | HIGH to OFF-state propagation delay | OE → nQ; see Figure 5 | 5 V | | | - | 45 | 90 | ns |
| | | | 10 V | | | - | 20 | 35 | ns |
| | | | 15 V | | | - | 10 | 25 | ns |
| $t_{PLZ}$ | LOW to OFF-state propagation delay | OE → nQ; see Figure 5 | 5 V | | | - | 50 | 100 | ns |
| | | | 10 V | | | - | 20 | 40 | ns |
| | | | 15 V | | | - | 10 | 25 | ns |
| $t_{PZH}$ | OFF-state to HIGH propagation delay | OE → nQ; see Figure 5 | 5 V | | | - | 25 | 50 | ns |
| | | | 10 V | | | - | 15 | 30 | ns |
| | | | 15 V | | | - | 10 | 25 | ns |
| $t_{PZL}$ | OFF-state to LOW propagation delay | OE → nQ; see Figure 5 | 5 V | | | - | 40 | 80 | ns |
| | | | 10 V | | | - | 20 | 45 | ns |
| | | | 15 V | | | - | 15 | 35 | ns |
| $t_W$ | pulse width | nS input HIGH; minimum width; see Figure 4 | 5 V | | | 30 | 15 | - | ns |
| | | | 10 V | | | 20 | 10 | - | ns |
| | | | 15 V | | | 16 | 8 | - | ns |
| | | nR input HIGH; minimum width; see Figure 4 | 5 V | | | 30 | 15 | - | ns |
| | | | 10 V | | | 20 | 10 | - | ns |
| | | | 15 V | | | 16 | 8 | - | ns |

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

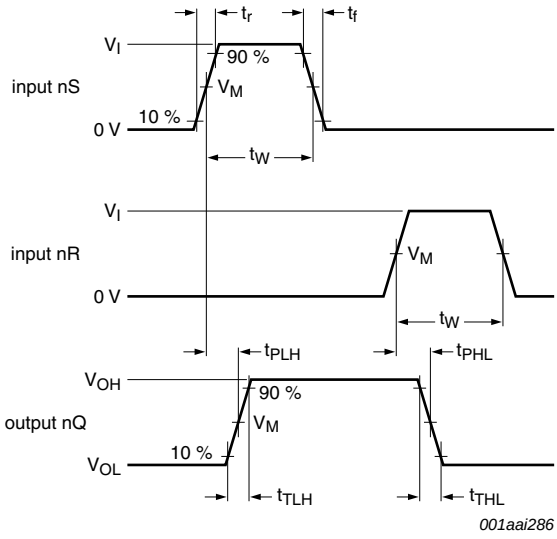
[2] $t_t$ is the same as $t_{THL}$ and $t_{TLH}$.

**Table 8. Dynamic power dissipation $P_D$**

*$P_D$ can be calculated from the formulas shown. $V_{SS}$ = 0 V; $t_r = t_f \leq 20$ ns; $T_{amb}$ = 25 °C.*

| Symbol | Parameter | $V_{DD}$ | Typical formula for $P_D$ (μW) | where: |
|---|---|---|---|---|
| $P_D$ | dynamic power dissipation | 5 V | $P_D = 1100 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ | $f_i$ = input frequency in MHz; |
| | | 10 V | $P_D = 4400 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ | $f_o$ = output frequency in MHz; |
| | | 15 V | $P_D = 11400 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ | $C_L$ = output load capacitance in pF; |
| | | | | $V_{DD}$ = supply voltage in V; |
| | | | | $\Sigma(f_o \times C_L)$ = sum of the outputs. |

## 12. Waveforms



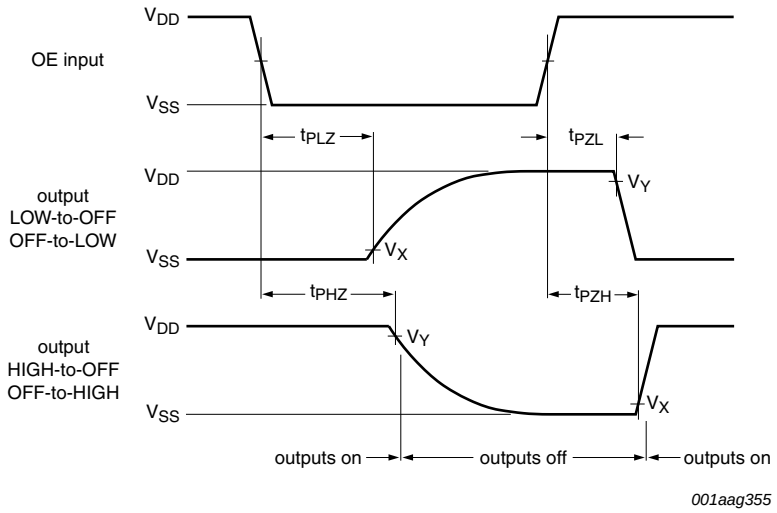

$t_r$ and $t_f$ are the input rise and fall times.

Logic levels: $V_{OL}$ and $V_{OH}$ are typical output voltage levels that occur with the output load.

Transition times: transition time ($t_t$) = HIGH LOW ($t_{THL}$) or LOW HIGH ($t_{TLH}$) transition times.

Measurement points are given in Table 9 and test data is given in Table 10.

**Fig 4. Input minimum set (nS) and reset (nR) pulse widths, inputs nS or nR to latch output (nQ) propagation delay and nQ transition time**

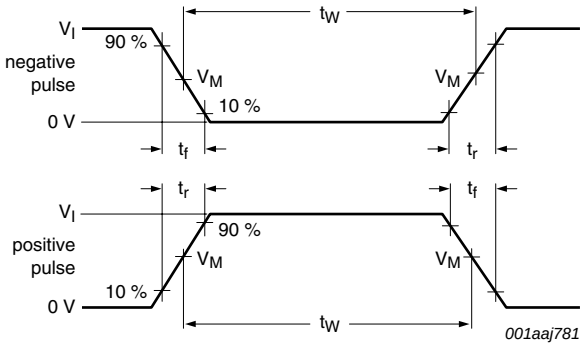



Measurement points are given in Table 9.

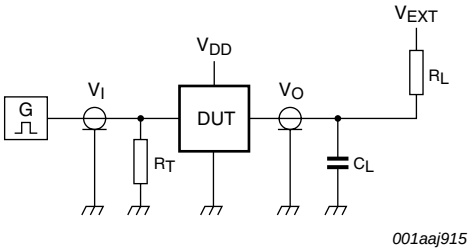
**Fig 5. Output enable (OE) to latch output (nQ) enable time ($t_{PZL}$ and $t_{PZH}$) and disable time ($t_{PLZ}$ and $t_{PHZ}$)**

**Table 9. Measurement points**

| Supply voltage | Input | | Output | | |
|---|---|---|---|---|---|
| $V_{DD}$ | $V_I$ | $V_M$ | $V_M$ | $V_X$ | $V_Y$ |
| 5 V to 15 V | $V_{DD}$ or 0 V | $0.5V_{DD}$ | $0.5V_{DD}$ | $0.1V_{DD}$ | $0.9V_{DD}$ |




a. Input waveform




b. Test circuit

Test and measurement data is given in Table 10.

Definitions test circuit:

DUT = Device Under Test.

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

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

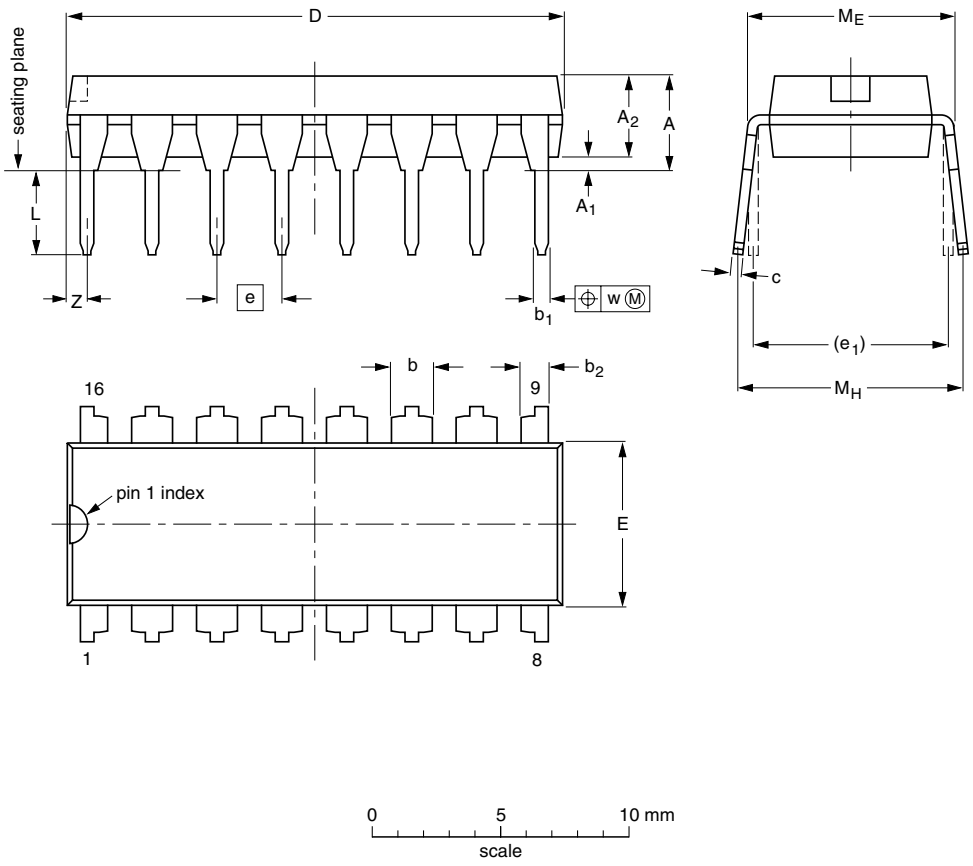
**Fig 6. Test circuit for measuring switching times**

**Table 10. Test data**

| Supply voltage | Input | | Load | | $V_{EXT}$ | | |
|---|---|---|---|---|---|---|---|
| | $V_I$ | $t_r$, $t_f$ | $C_L$ | $R_L$ | $t_{PLH}$, $t_{PHL}$ | $t_{PLZ}$, $t_{PZL}$ | $t_{PHZ}$, $t_{PZH}$ |
| 5 V to 15 V | $V_{DD}$ | ≤ 20 ns | 50 pF | 1 kΩ | open | $V_{DD}$ | GND |

## 13. Package outline

**DIP16: plastic dual in-line package; 16 leads (300 mil)** **SOT38-4**




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

| UNIT | A max. | $A_1$ min. | $A_2$ max. | b | $b_1$ | $b_2$ | c | D (1) | E (1) | e | $e_1$ | L | $M_E$ | $M_H$ | w | Z (1) max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.2 | 0.51 | 3.2 | 1.73<br>1.30 | 0.53<br>0.38 | 1.25<br>0.85 | 0.36<br>0.23 | 19.50<br>18.55 | 6.48<br>6.20 | 2.54 | 7.62 | 3.60<br>3.05 | 8.25<br>7.80 | 10.0<br>8.3 | 0.254 | 0.76 |
| inches | 0.17 | 0.02 | 0.13 | 0.068<br>0.051 | 0.021<br>0.015 | 0.049<br>0.033 | 0.014<br>0.009 | 0.77<br>0.73 | 0.26<br>0.24 | 0.1 | 0.3 | 0.14<br>0.12 | 0.32<br>0.31 | 0.39<br>0.33 | 0.01 | 0.03 |

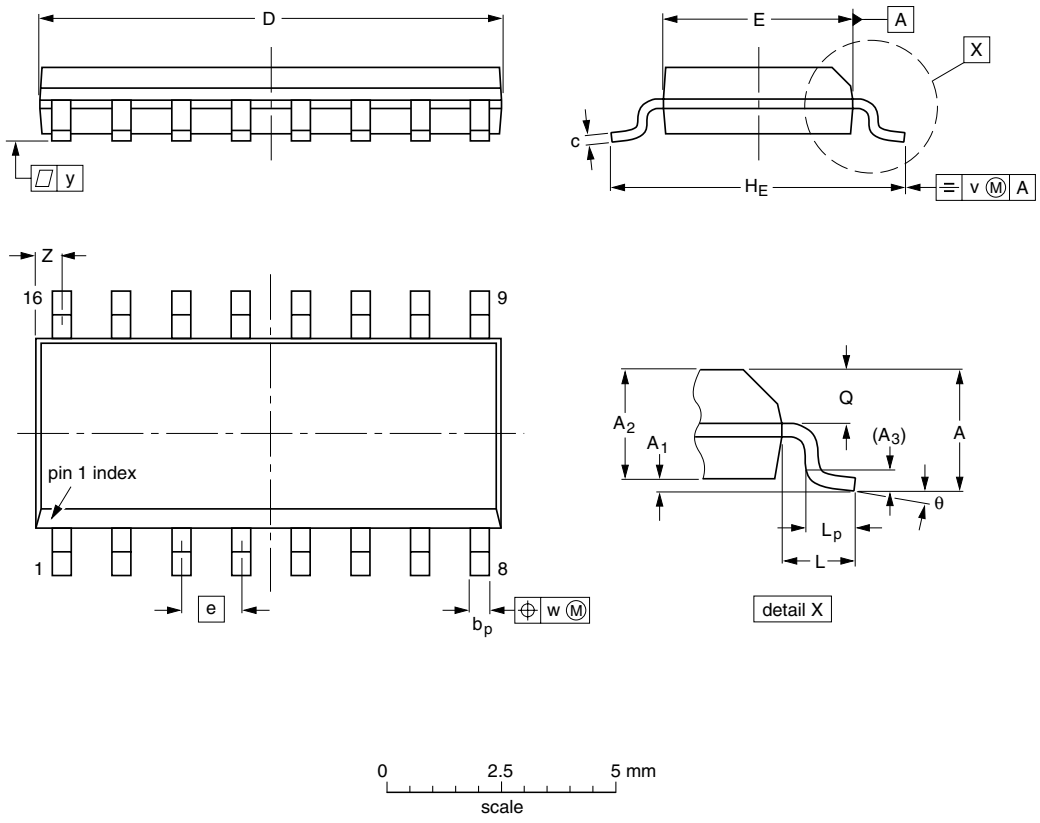
**Note**

1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT38-4 | | | | | | ~~95-01-14~~<br>03-02-13 |

**Fig 7. Package outline SOT38-4 (DIP16)**

**SO16: plastic small outline package; 16 leads; body width 3.9 mm** **SOT109-1**




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

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(1)}$ | e | $H_E$ | L | $L_p$ | Q | v | w | y | $Z^{(1)}$ | 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 | 10.0<br>9.8 | 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 | 0.39<br>0.38 | 0.16<br>0.15 | 0.05 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.020 | 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 VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT109-1 | 076E07 | MS-012 | | | | ~~99-12-27~~<br>03-02-19 |

**Fig 8. Package outline SOT109-1 (SO16)**

## 14. Revision history

**Table 11. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| HEF4043B_9 | 20091216 | Product data sheet | - | HEF4043B_8 |
| Modifications: | • Section 12 “Waveforms” Table 10 “Test data” $t_{PLZ}$ and $t_{PZL}$ value updated. | | | |
| HEF4043B_8 | 20091127 | Product data sheet | - | HEF4043B_7 |
| HEF4043B_7 | 20090710 | Product data sheet | - | HEF4043B_6 |
| HEF4043B_6 | 20081111 | Product data sheet | - | HEF4043B_5 |
| HEF4043B_5 | 20080729 | Product data sheet | - | HEF4043B_4 |
| HEF4043B_4 | 20080710 | Product data sheet | - | HEF4043B_CNV_3 |
| HEF4043B_CNV_3 | 19950101 | Product specification | - | HEF4043B_CNV_2 |
| HEF4043B_CNV_2 | 19950101 | Product specification | - | - |

# 15. Legal information

## 15.1 Data sheet status

| Document status[1][2] | Product status[3] | 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.nxp.com.

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