

HEF4081B

Quad 2-input AND gate

Rev. 06 — 2 December 2009

Product data sheet

1. General description

The HEF4081B is a quad 2-input AND gate. The outputs are fully buffered for highest noise immunity and pattern insensitivity to output impedance variations.

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. The HEF4081B is suitable for use over both the industrial ($-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$) and automotive ($-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$) temperature ranges.

2. Features

- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Inputs and outputs are protected against electrostatic effects
- Operates across the automotive temperature range from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- Complies with JEDEC standard JESD 13-B

3. Ordering information

Table 1. Ordering information

All types operate from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$.

| Type number | Package | | |
|-------------|---------|--|----------|
| | Name | Description | Version |
| HEF4081BP | DIP14 | plastic dual in-line package; 14 leads (300 mil) | SOT27-1 |
| HEF4081BT | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |

4. Functional diagram

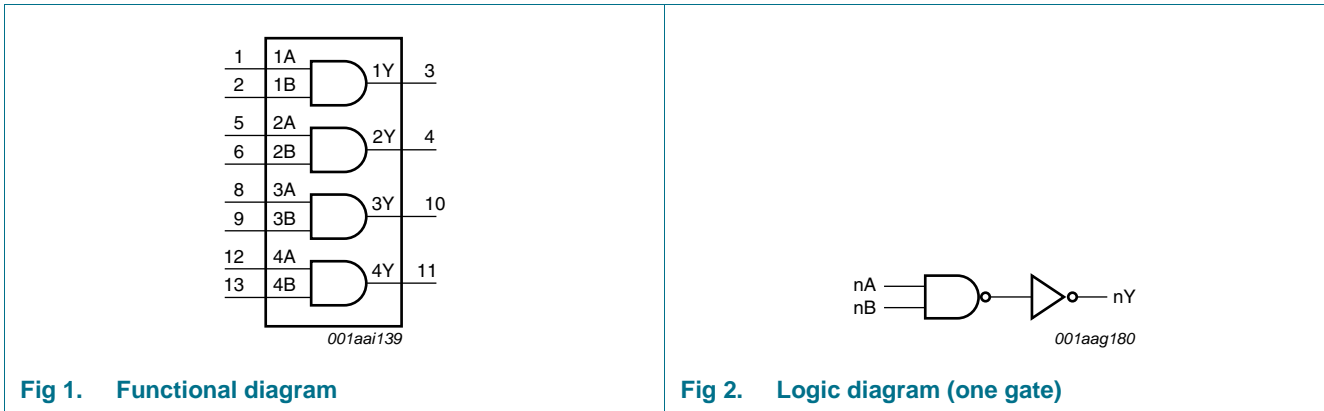


Fig 1. Functional diagram

Fig 2. Logic diagram (one gate)

5. Pinning information

5.1 Pinning

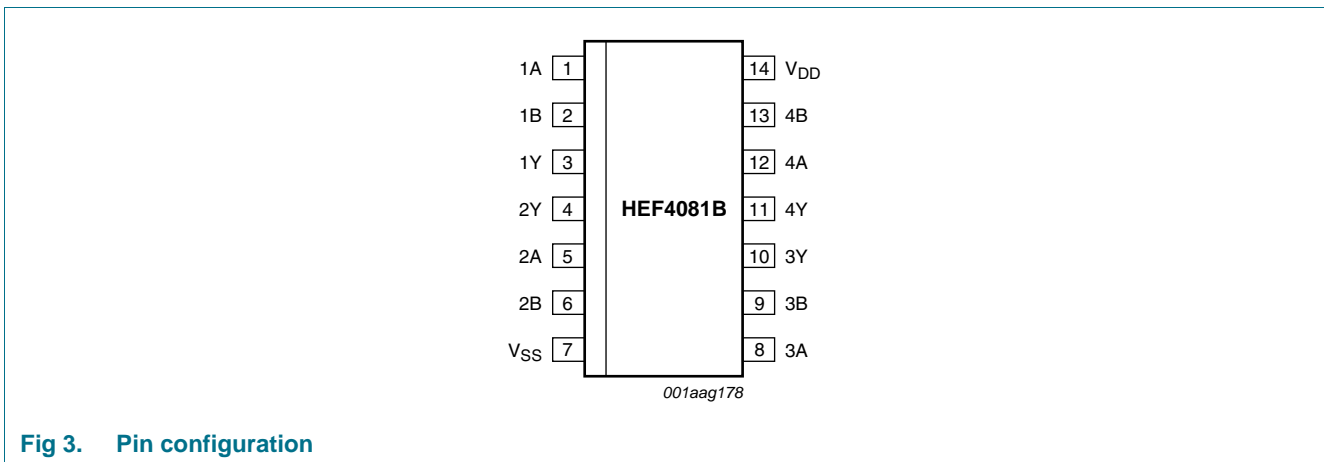


Fig 3. Pin configuration

5.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|-----------------|--------------|----------------|
| 1A to 4A | 1, 5, 8, 12 | input |
| 1B to 4B | 2, 6, 9, 13 | input |
| 1Y to 4Y | 3, 4, 10, 11 | output |
| V _{SS} | 7 | ground (0 V) |
| V _{DD} | 14 | supply voltage |

6. Functional description

Table 3. Function table^[1]

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

[1] H = HIGH voltage level; L = LOW voltage level.

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to $V_{SS} = 0$ V (ground).

| 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 | +125 | °C |
| P_{tot} | total power dissipation | $T_{amb} = -40$ °C to + 125 °C | | | |
| | | DIP14 | ^[1] - | 750 | mW |
| | | SO14 | ^[2] - | 500 | mW |
| P | power dissipation | per output | - | 100 | mW |

[1] For DIP14 packages: above $T_{amb} = 70$ °C, P_{tot} derates linearly with 12 mW/K.

[2] For SO14 packages: above $T_{amb} = 70$ °C, P_{tot} derates linearly with 8 mW/K.

8. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | 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 | +125 | °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 | $\mu\text{s/V}$ |

9. Static characteristics

Table 6. Static characteristics

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

| Symbol | Parameter | Conditions | V_{DD} | $T_{amb} = -40\text{ }^{\circ}\text{C}$ | | $T_{amb} = +25\text{ }^{\circ}\text{C}$ | | $T_{amb} = +85\text{ }^{\circ}\text{C}$ | | $T_{amb} = +125\text{ }^{\circ}\text{C}$ | | Unit |
|----------|---------------------------|---|----------|---|-----------|---|-----------|---|-----------|--|-----------|---------------|
| | | | | Min | Max | Min | Max | Min | Max | Min | Max | |
| V_{IH} | HIGH-level input voltage | $ I_O < 1\text{ }\mu\text{A}$ | 5 V | 3.5 | - | 3.5 | - | 3.5 | - | 3.5 | - | V |
| | | | 10 V | 7.0 | - | 7.0 | - | 7.0 | - | 7.0 | - | V |
| | | | 15 V | 11.0 | - | 11.0 | - | 11.0 | - | 11.0 | - | V |
| V_{IL} | LOW-level input voltage | $ I_O < 1\text{ }\mu\text{A}$ | 5 V | - | 1.5 | - | 1.5 | - | 1.5 | - | 1.5 | V |
| | | | 10 V | - | 3.0 | - | 3.0 | - | 3.0 | - | 3.0 | V |
| | | | 15 V | - | 4.0 | - | 4.0 | - | 4.0 | - | 4.0 | V |
| V_{OH} | HIGH-level output voltage | $ I_O < 1\text{ }\mu\text{A}$ | 5 V | 4.95 | - | 4.95 | - | 4.95 | - | 4.95 | - | V |
| | | | 10 V | 9.95 | - | 9.95 | - | 9.95 | - | 9.95 | - | V |
| | | | 15 V | 14.95 | - | 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 | - | 0.05 | V |
| | | | 10 V | - | 0.05 | - | 0.05 | - | 0.05 | - | 0.05 | V |
| | | | 15 V | - | 0.05 | - | 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 | - | -1.1 | - | mA |
| | | $V_O = 4.6\text{ V}$ | 5 V | -0.64 | - | -0.5 | - | -0.36 | - | -0.36 | - | mA |
| | | $V_O = 9.5\text{ V}$ | 10 V | -1.6 | - | -1.3 | - | -0.9 | - | -0.9 | - | mA |
| | | $V_O = 13.5\text{ V}$ | 15 V | -4.2 | - | -3.4 | - | -2.4 | - | -2.4 | - | mA |
| I_{OL} | LOW-level output current | $V_O = 0.4\text{ V}$ | 5 V | 0.64 | - | 0.5 | - | 0.36 | - | 0.36 | - | mA |
| | | $V_O = 0.5\text{ V}$ | 10 V | 1.6 | - | 1.3 | - | 0.9 | - | 0.9 | - | mA |
| | | $V_O = 1.5\text{ V}$ | 15 V | 4.2 | - | 3.4 | - | 2.4 | - | 2.4 | - | mA |
| I_I | input leakage current | | 15 V | - | ± 0.1 | - | ± 0.1 | - | ± 1.0 | - | ± 1.0 | μA |
| I_{DD} | supply current | all valid input combinations; $I_O = 0\text{ A}$ | 5 V | - | 0.25 | - | 0.25 | - | 7.5 | - | 7.5 | μA |
| | | | 10 V | - | 0.5 | - | 0.5 | - | 15.0 | - | 15.0 | μA |
| | | | 15 V | - | 1.0 | - | 1.0 | - | 30.0 | - | 30.0 | μA |
| C_I | input capacitance | | | - | - | - | 7.5 | - | - | - | pF | |

10. Dynamic characteristics

Table 7. Dynamic characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$; for waveforms see [Figure 4](#); for test circuit see [Figure 5](#); unless otherwise specified. [1]

| Symbol | Parameter | Conditions | V _{DD} | Extrapolation formula | Min | Typ | Max | Unit |
|------------------|------------------------------------|----------------|-----------------|------------------------------------|-----|-----|-----|------|
| t _{PHL} | HIGH to LOW propagation delay | nA or nB to nY | 5 V | 28 ns + (0.55 ns/pF)C _L | - | 55 | 110 | ns |
| | | | 10 V | 14 ns + (0.23 ns/pF)C _L | - | 25 | 50 | ns |
| | | | 15 V | 12 ns + (0.16 ns/pF)C _L | - | 20 | 40 | ns |
| t _{PLH} | LOW to HIGH propagation delay | nA or nB to nY | 5 V | 18 ns + (0.55 ns/pF)C _L | - | 45 | 90 | ns |
| | | | 10 V | 9 ns + (0.23 ns/pF)C _L | - | 20 | 40 | ns |
| | | | 15 V | 7 ns + (0.16 ns/pF)C _L | - | 15 | 30 | ns |
| t _{THL} | HIGH to LOW output transition time | | 5 V | 10 ns + (1.0 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 _{TLH} | LOW to HIGH output transition time | | 5 V | 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 |

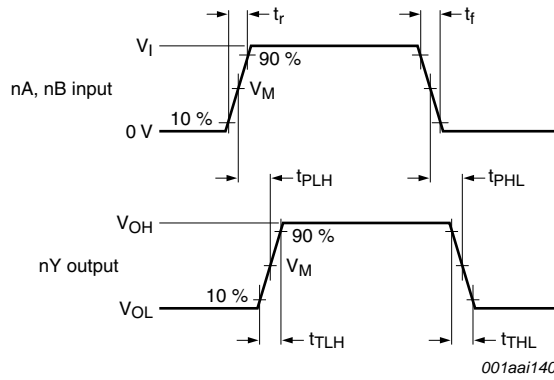
[1] The typical value of the propagation delay and output transition time can be calculated with the extrapolation formula (C_L in pF).

Table 8. Dynamic power dissipation

$V_{SS} = 0\text{ V}$; $t_r = t_f \leq 20\text{ ns}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

| Symbol | Parameter | V _{DD} | Typical formula | where: |
|----------------|---------------------------|-----------------|--|--|
| P _D | dynamic power dissipation | 5 V | $P_D = 450 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW) | f _i = input frequency in MHz; |
| | | 10 V | $P_D = 2900 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW) | f _o = output frequency in MHz; |
| | | 15 V | $P_D = 11700 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW) | C _L = output load capacitance in pF; Σ(f _o × C _L) = sum of the outputs; V _{DD} = supply voltage in V. |

11. Waveforms

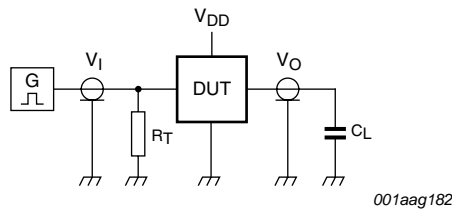


Measurement points are given in [Table 9](#).
 Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 4. Input to output propagation delay and output transition times

Table 9. Measurement points

| Supply voltage | Input | Output |
|----------------|-------------|-------------|
| V_{DD} | V_M | V_M |
| 5 V to 15 V | $0.5V_{DD}$ | $0.5V_{DD}$ |



Test data is given in [Table 10](#).
 Definitions for test circuit:
 DUT = Device Under Test.
 C_L = load capacitance including jig and probe capacitance.
 R_T = termination resistance should be equal to the output impedance Z_o of the pulse generator.

Fig 5. Test circuit

Table 10. Test data

| Supply voltage | Input | Load |
|----------------|----------------------|--------------|
| V_{DD} | V_I | C_L |
| 5 V to 15 V | V_{SS} or V_{DD} | 50 pF |
| | | t_r, t_f |
| | | ≤ 20 ns |

12. Package outline

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1

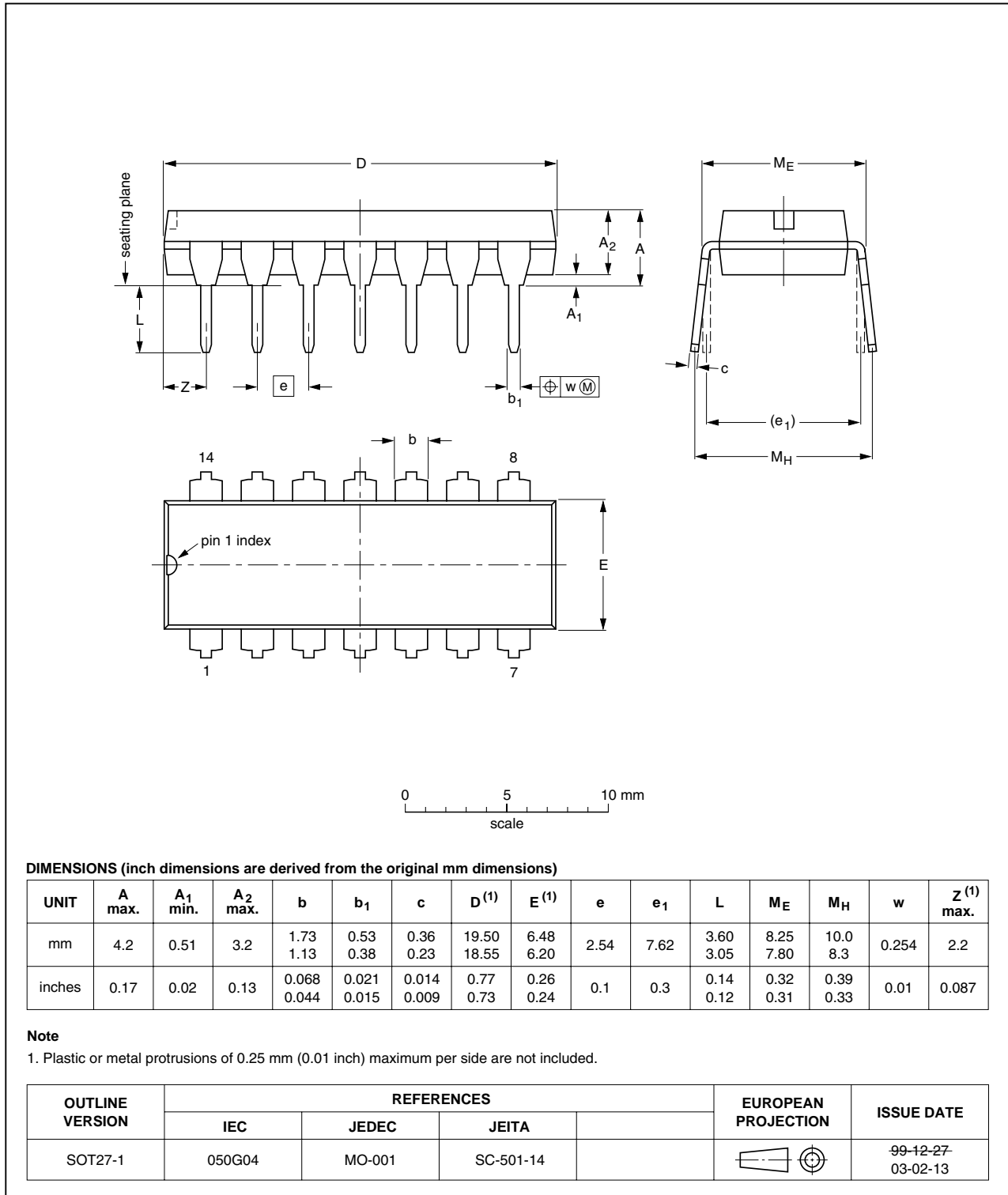


Fig 6. Package outline SOT27-1 (DIP14)

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

SOT108-1

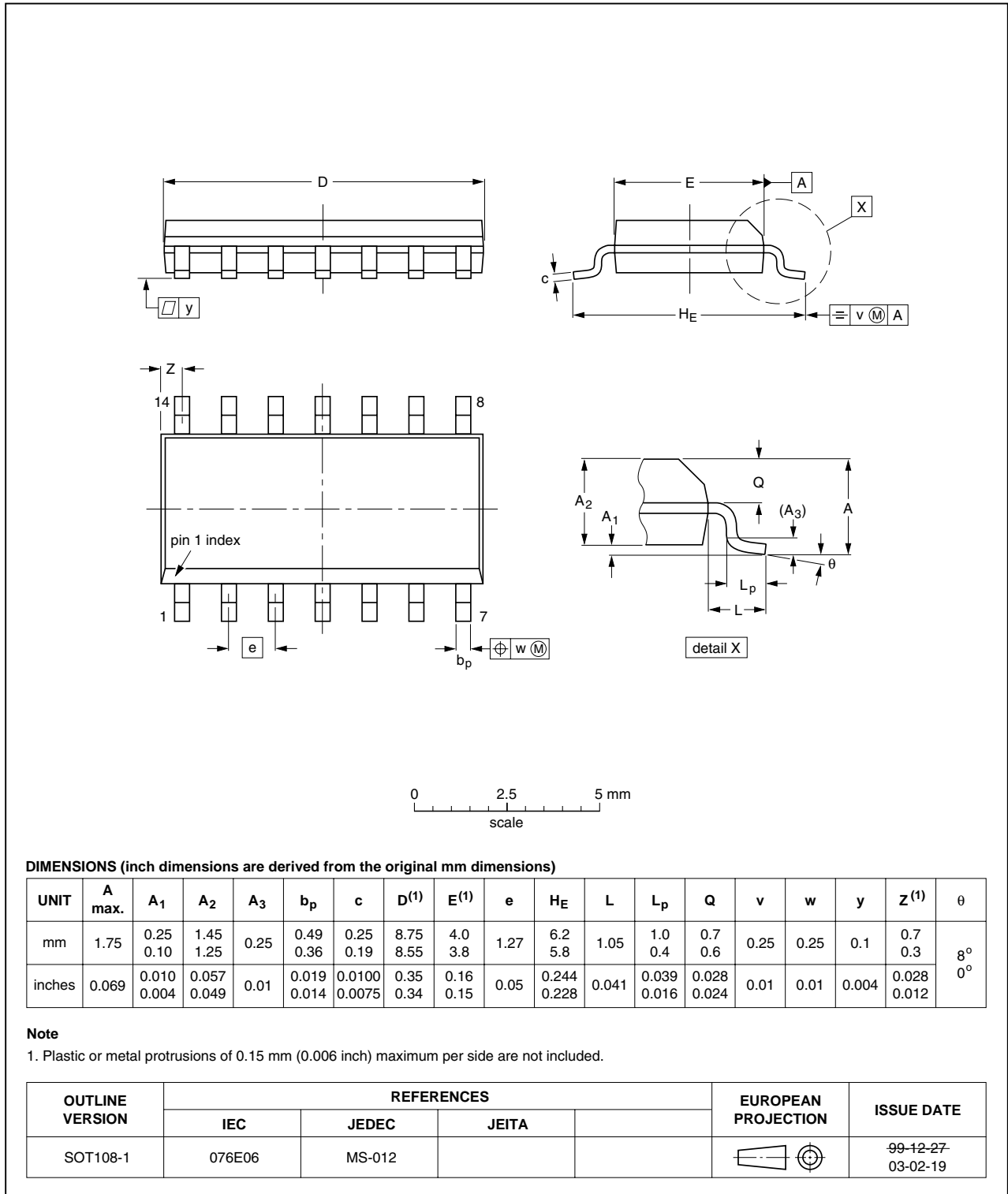


Fig 7. Package outline SOT108-1 (SO14)

13. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--|-----------------------|---------------|----------------|
| HEF4081B_6 | 20091202 | Product data sheet | - | HEF4081B_5 |
| Modifications: | • Section 8 "Recommended operating conditions" , $\Delta t/\Delta V$ values updated. | | | |
| HEF4081B_5 | 20090629 | Product data sheet | - | HEF4081B_4 |
| HEF4081B_4 | 20080526 | Product data sheet | - | HEF4081B_CNV_3 |
| HEF4081B_CNV_3 | 19950101 | Product specification | - | HEF4081B_CNV_2 |
| HEF4081B_CNV_2 | 19950101 | Product specification | - | - |

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14.1 Data sheet status

| Document status ^{[1][2]} | Product status ^[3] | Definition |
|-----------------------------------|-------------------------------|---|
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| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
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[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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