



**THE DATASHEET OF  
HEF4077BT,653**



# HEF4077B

## Quad 2-input EXCLUSIVE-NOR gate

Rev. 6 — 14 March 2017

Product data sheet

### 1 General description

The HEF4077B is a quad 2-input EXCLUSIVE-NOR gate. The outputs are fully buffered for the highest noise immunity and pattern insensitivity to output impedance.

The HEF4077B 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

- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Specified from -40 °C to +85 °C
- Complies with JEDEC standard JESD 13-B

### 3 Ordering information

Table 1. Ordering information

| Type number | Package           |      |  | Version  |
|-------------|-------------------|------|--|----------|
|             | Temperature range | Name | Description  |          |
| HEF4077BT   | -40 °C to +85 °C  | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |

### 4 Functional diagram

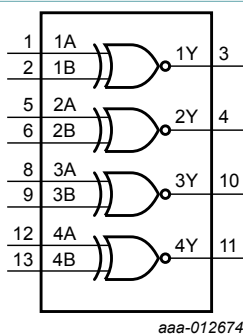


Figure 1. Functional diagram

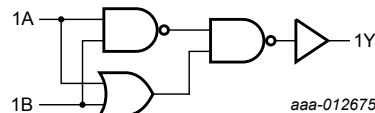


Figure 2. Logic diagram (one gate)

## 5 Pinning information

### 5.1 Pinning

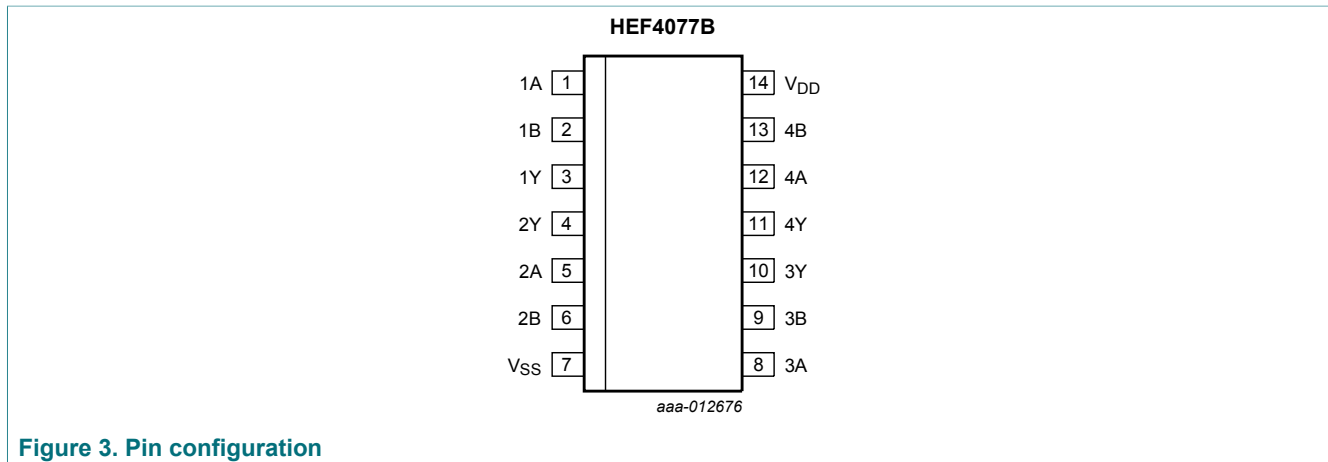


Figure 3. Pin configuration

### 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 <sub>SS</sub> | 7            | ground (0 V)   |
| V <sub>DD</sub> | 14           | supply voltage |

## 6 Functional description

Table 3. Functional table <sup>[1]</sup>

| Input |    | Output |
|-------|----|--------|
| nA    | nB | nY     |
| L     | L  | H      |
| 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  $V_{SS} = 0\text{ V}$  (ground).

| Symbol    | Parameter               | Conditions   | Min  | Max            | Unit |
|-----------|-------------------------|--|------|----------------|------|
| $V_{DD}$  | supply voltage          |  | -0.5 | +18            | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5\text{ V}$ or $V_I > V_{DD} + 0.5\text{ V}$ | -    | $\pm 10$       | mA   |
| $V_I$     | input voltage           |  | -0.5 | $V_{DD} + 0.5$ | V    |
| $I_{OK}$  | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{DD} + 0.5\text{ V}$ | -    | $\pm 10$       | 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 | $T_{amb} = -40\text{ °C}$ to $+85\text{ °C}$           |      |                |      |
|           |                         | SO14 package [1]                                       | -    | 500            | mW   |
| $P$       | power dissipation       | per output   | -    | 100            | mW   |

[1] For SO14 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

## 8 Recommended operating conditions

**Table 5. 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 | +85      | °C              |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{DD} = 5\text{ V}$  | -   | 3.75     | $\mu\text{s/V}$ |
|                     |                                     | $V_{DD} = 10\text{ V}$ | -   | 0.5      | $\mu\text{s/V}$ |
|                     |                                     | $V_{DD} = 15\text{ V}$ | -   | 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  | $V_{DD}$ | $T_{amb} = -40\text{ }^{\circ}\text{C}$ |           | $T_{amb} = 25\text{ }^{\circ}\text{C}$ |           | $T_{amb} = 85\text{ }^{\circ}\text{C}$ |           | Unit          |
|----------|---------------------------|---|----------|---|-----------|--|-----------|--|-----------|---------------|
|          |                           |   |          | 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                                    | -         | 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\text{ }\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             |
| $V_{OH}$ | 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  | $V_O = 0.4\text{ V}$                                | 5 V      | 0.52                                    | -         | 0.44                                   | -         | 0.36                                   | -         | mA            |
|          |                           | $V_O = 0.5\text{ V}$                                | 10 V     | 1.3                                     | -         | 1.1                                    | -         | 0.9                                    | -         | mA            |
|          |                           | $V_O = 1.5\text{ V}$                                | 15 V     | 3.6                                     | -         | 3.0                                    | -         | 2.4                                    | -         | mA            |
| $I_I$    | input leakage current     |   | 15 V     | -                                       | $\pm 0.3$ | -                                      | $\pm 0.3$ | -                                      | $\pm 3.0$ | $\mu\text{A}$ |
| $I_{DD}$ | supply current            | all valid input combinations;<br>$I_O = 0\text{ A}$ | 5 V      | -                                       | 1.0       | -                                      | 1.0       | -                                      | 7.5       | $\mu\text{A}$ |
|          |                           |   | 10 V     | -                                       | 2.0       | -                                      | 2.0       | -                                      | 15.0      | $\mu\text{A}$ |
|          |                           |   | 15 V     | -                                       | 4.0       | -                                      | 4.0       | -                                      | 30.0      | $\mu\text{A}$ |
| $C_I$    | input capacitance         |   | -        | -                                       | -         | -                                      | 7.5       | -                                      | -         | pF            |

## 10 Dynamic characteristics

**Table 7. Dynamic characteristics** <sup>[1]</sup>

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

| Symbol           | Parameter                     | Conditions     | V <sub>DD</sub>    | Extrapolation formula              | Min | Typ | Max | Unit |
|------------------|-------------------------------|----------------|--------------------|------------------------------------|-----|-----|-----|------|
| t <sub>PHL</sub> | HIGH to LOW propagation delay | nA or nB to nY | 5 V                | 48 ns + (0.55 ns/pF)C <sub>L</sub> | -   | 75  | 150 | ns   |
|                  |                               |                | 10 V               | 24 ns + (0.23 ns/pF)C <sub>L</sub> | -   | 35  | 70  | ns   |
|                  |                               |                | 15 V               | 22 ns + (0.16 ns/pF)C <sub>L</sub> | -   | 30  | 55  | ns   |
| t <sub>PLH</sub> | LOW to HIGH propagation delay | nA or nB to nY | 5 V                | 43 ns + (0.55 ns/pF)C <sub>L</sub> | -   | 70  | 145 | ns   |
|                  |                               |                | 10 V               | 19 ns + (0.23 ns/pF)C <sub>L</sub> | -   | 30  | 60  | ns   |
|                  |                               |                | 15 V               | 17 ns + (0.16 ns/pF)C <sub>L</sub> | -   | 25  | 50  | ns   |
| t <sub>t</sub>   | transition time               | nY             | 5 V <sup>[2]</sup> | 10 ns + (1.00 ns/pF)C <sub>L</sub> | -   | 60  | 120 | ns   |
|                  |                               |                | 10 V               | 9 ns + (0.42 ns/pF)C <sub>L</sub>  | -   | 30  | 60  | ns   |
|                  |                               |                | 15 V               | 6 ns + (0.28 ns/pF)C <sub>L</sub>  | -   | 20  | 40  | ns   |

[1] The typical value of the propagation delay and output transition time can be calculated with the extrapolation formula (C<sub>L</sub> in pF).

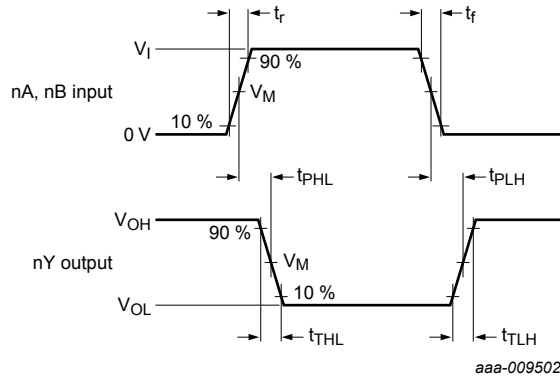
[2] t<sub>t</sub> is the same as t<sub>T<sub>HL</sub></sub> and t<sub>T<sub>LH</sub></sub>.

**Table 8. Dynamic power dissipation**

V<sub>SS</sub> = 0 V; t<sub>r</sub> = t<sub>f</sub> ≤ 20 ns; T<sub>amb</sub> = 25 °C.

| Symbol         | Parameter                 | V <sub>DD</sub> | Typical formula   | where:  |
|----------------|---------------------------|-----------------|---|---|
| P <sub>D</sub> | dynamic power dissipation | 5 V             | $P_D = 850 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW)    | f <sub>i</sub> = input frequency in MHz;<br>f <sub>o</sub> = output frequency in MHz;<br>C <sub>L</sub> = output load capacitance in pF;<br>Σ(f <sub>o</sub> × C <sub>L</sub> ) = sum of the outputs;<br>V <sub>DD</sub> = supply voltage in V. |
|                |                           | 10 V            | $P_D = 4500 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW)   |   |
|                |                           | 15 V            | $P_D = 114700 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW) |   |

10.1 Waveform and test circuit



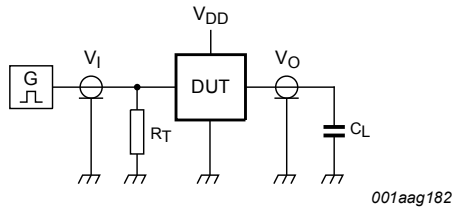
Measurement points are given in [Table 9](#).

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

Figure 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:

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

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

Figure 5. Test circuit

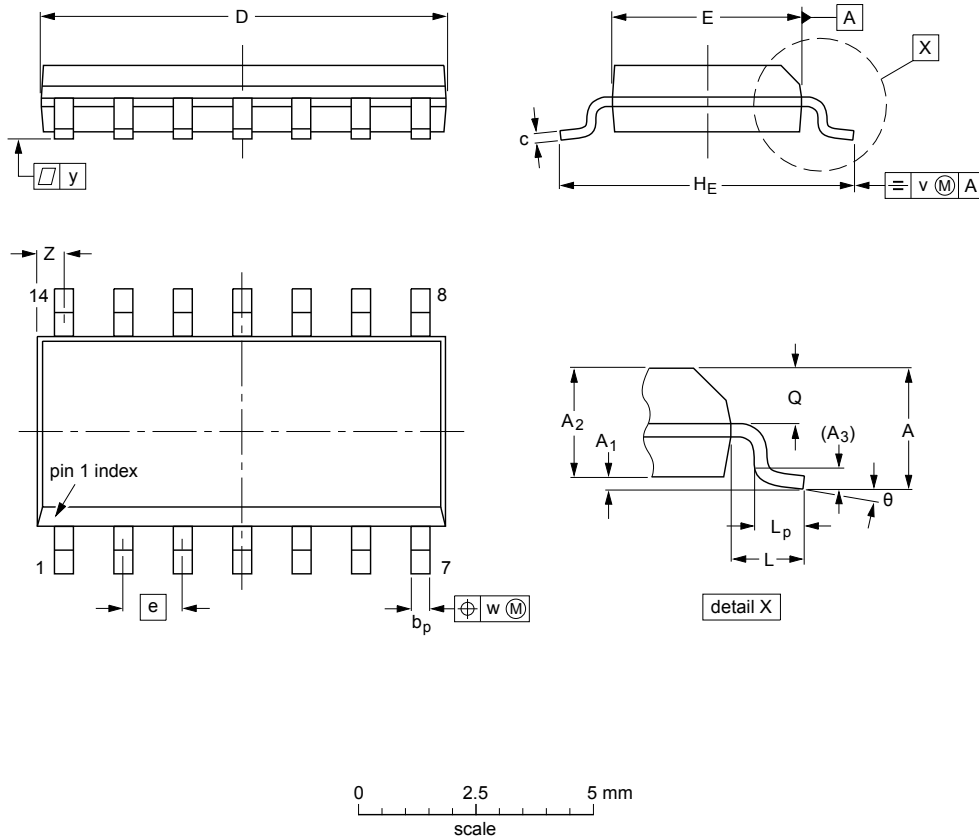
Table 10. Test data

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

11 Package outline

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

Figure 6. Package outline SOT108-1 (SO14)

## 12 Abbreviations

Table 11. Abbreviations

| Acronym | Description             |
|---------|-------------------------|
| DUT     | Device Under Test       |
| ESD     | ElectroStatic Discharge |

## 13 Revision history

Table 12. Revision history

| Document ID    | Release date  | Data sheet status     | Change notice | Supersedes     |
|----------------|---|-----------------------|---------------|----------------|
| HEF4077B v.6   | 20170314  | Product data sheet    | -             | HEF4077B v.5   |
| Modifications: | <ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>   |                       |               |                |
| HEF4077B v.5   | 20151210  | Product data sheet    | -             | HEF4077B v.4   |
| Modifications: | <ul style="list-style-type: none"> <li>Type number HEF4077BP (SOT27-1) removed.</li> </ul>  |                       |               |                |
| HEF4077B v.4   | 20140718  | Product data sheet    | -             | HEF4077B_CNV_3 |
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| HEF4077B_CNV_3 | 19950101  | Product specification | -             | -              |

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| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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.

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-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management