

HEF4070B-Q100

Quad 2-input EXCLUSIVE-OR gate

Rev. 4 — 5 September 2024

Product data sheet

1. General description

The HEF4070B-Q100 is a quad 2-input EXCLUSIVE-OR gate. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{DD} .

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 3) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 3)
 - Specified from -40 °C to +85 °C
- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- CMOS low power dissipation
- High noise immunity
- Standardized symmetrical output characteristics
- Complies with JEDEC standard JESD 13-B
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V

3. Applications

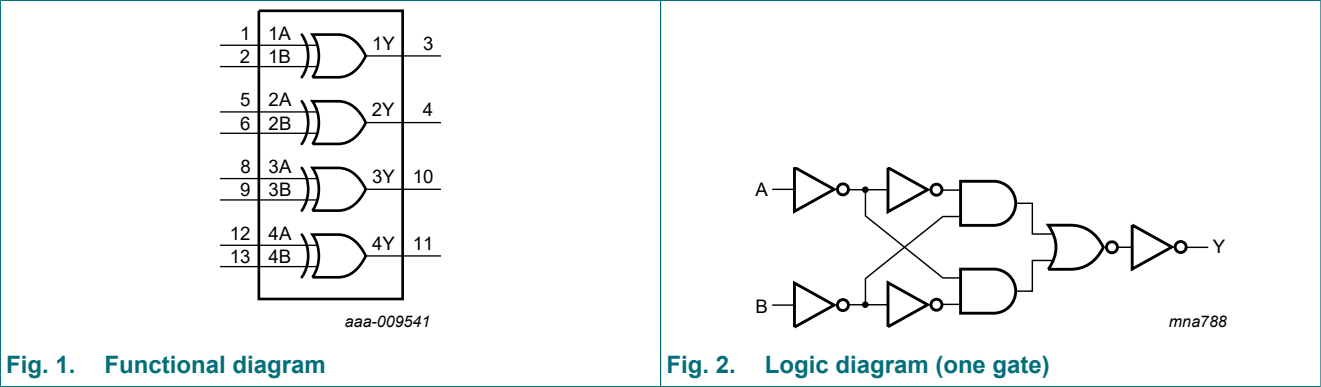
- Logical comparators
- Parity checkers and generators

4. Ordering information

Table 1. Ordering information

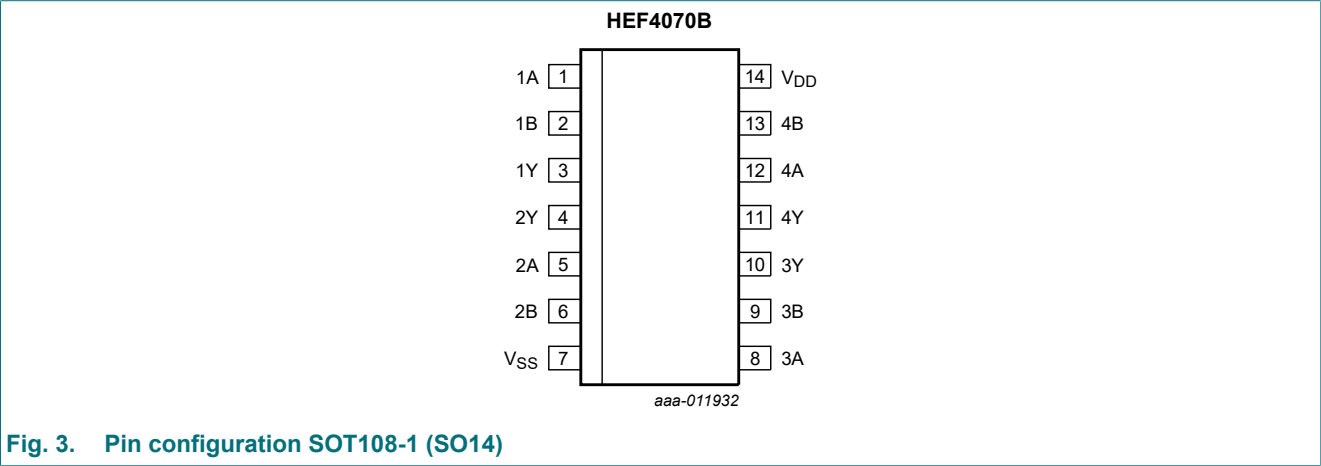
Type number	Package			
	Temperature range	Name	Description	Version
HEF4070BT-Q100	-40 °C to +85 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1

5. Functional diagram



6. Pinning information

6.1. Pinning



6.2. Pin description

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

7. Functional description

Table 3. Functional table

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

Input		Output
nA	nB	nY
L	L	L
L	H	H
H	L	H
H	H	L

8. 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 $V_I > V_{DD} + 0.5\text{ V}$	-	± 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 $V_O > V_{DD} + 0.5\text{ V}$	-	± 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	$T_{amb} = -40\text{ °C}$ to $+85\text{ °C}$	-	500	mW
P	power dissipation	per output	-	100	mW

9. 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	+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	$\mu\text{s/V}$

10. 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 °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 _{DD}	supply current	all valid input combinations; I _O = 0 A	5 V	-	1.0	-	1.0	-	7.5	µA
			10 V	-	2.0	-	2.0	-	15.0	µA
			15 V	-	4.0	-	4.0	-	30.0	µA
C _I	input capacitance			-	-	-	7.5	-	-	pF

11. Dynamic characteristics

Table 7. Dynamic characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified. For waveforms see Fig. 4; for test circuit see Fig. 5.

Symbol	Parameter[1]	Conditions	V _{DD}	Extrapolation formula	Min	Typ	Max	Unit
t _{PHL}	HIGH to LOW propagation delay	nA or nB to nY	5 V	58 ns + (0.55 ns/pF)C _L	-	85	175	ns
			10 V	24 ns + (0.23 ns/pF)C _L	-	35	75	ns
			15 V	21 ns + (0.16 ns/pF)C _L	-	30	55	ns
t _{PLH}	LOW to HIGH propagation delay	nA or nB to nY	5 V	43 ns + (0.55 ns/pF)C _L	-	75	150	ns
			10 V	19 ns + (0.23 ns/pF)C _L	-	30	65	ns
			15 V	17 ns + (0.16 ns/pF)C _L	-	25	50	ns
t _t	transition time		5 V [2]	10 ns + (1.00 ns/pF)C _L	-	60	120	ns
			10 V [2]	9 ns + (0.42 ns/pF)C _L	-	30	60	ns
			15 V [2]	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).

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

Table 8. Dynamic power dissipation

V_{SS} = 0 V; t_r = t_f ≤ 20 ns; T_{amb} = 25 °C.

Symbol	Parameter	V _{DD}	Typical formula	where:
P _D	dynamic power dissipation	5 V	$P_D = 1100 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW)	f _i = input frequency in MHz; f _o = output frequency in MHz; C _L = output load capacitance in pF; Σ(f _o × C _L) = sum of the outputs; V _{DD} = supply voltage in V.
		10 V	$P_D = 4900 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW)	
		15 V	$P_D = 14400 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW)	

11.1. Waveforms

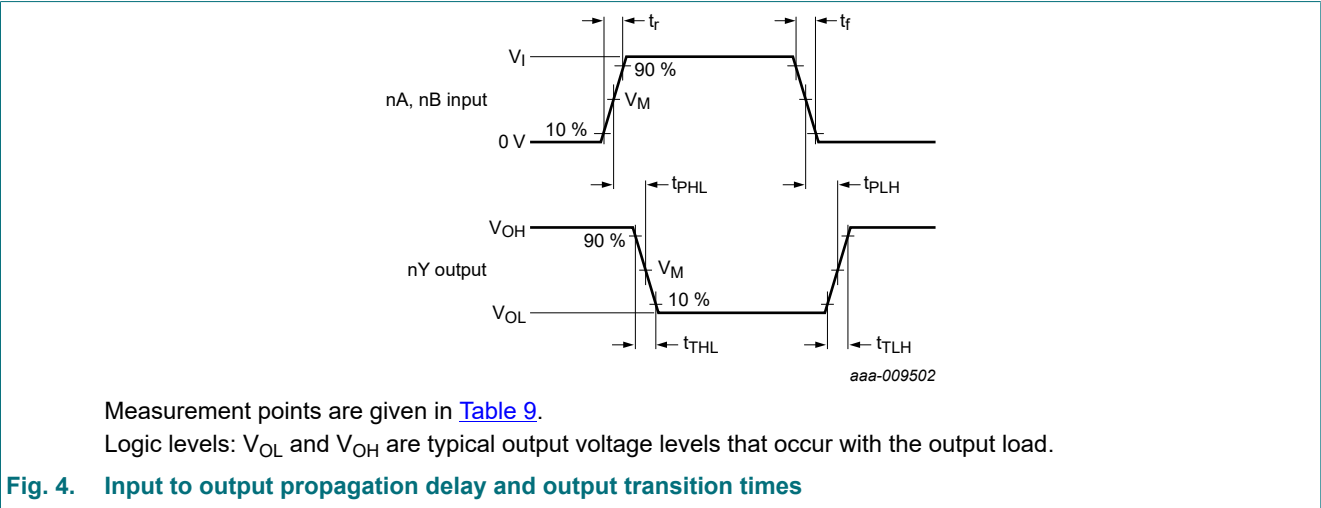
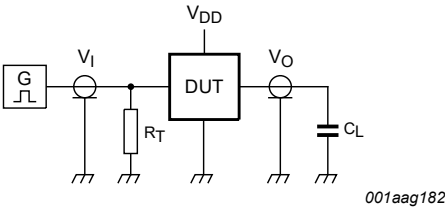


Table 9. Measurement points

Supply voltage	Input	Output
V _{DD}	V _M	V _M
5 V to 15 V	0.5 × V _{DD}	0.5 × V _{DD}



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

Fig. 5. Test circuit for measuring switching times

Table 10. Test data

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

12. Package outline

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

SOT108-1

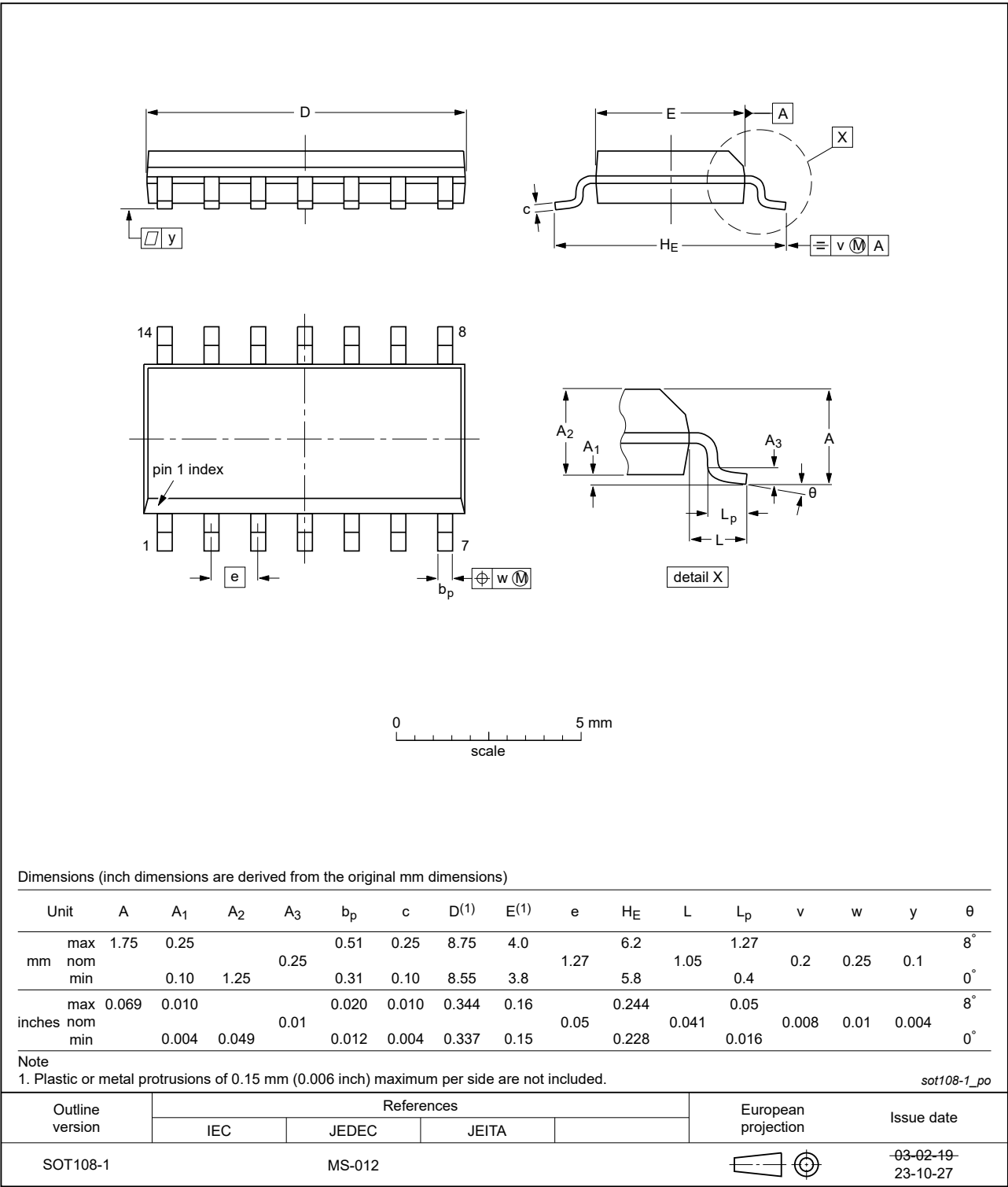


Fig. 6. Package outline SOT108-1 (SO14)

13. Abbreviations

Table 11. Abbreviations

Acronym	Description
ANSI	American National Standards Institute
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
ESDA	ElectroStatic Discharge Association
HBM	Human Body Model
JEDEC	Joint Electron Device Engineering Council

14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4070B_Q100 v.4	20240905	Product data sheet	-	HEF4070B_Q100 v.3
Modifications:	- Section 2: ESD specification updated according to the latest JEDEC standard. - Fig. 6: Aligned SO package outline drawing to JEDEC MS-012			
HEF4070B_Q100 v.3	20220211	Product data sheet	-	HEF4070B_Q100 v.2
Modifications:	- The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. - Legal texts have been adapted to the new company name where appropriate. - Section 1 and Section 2 updated.			
HEF4070B_Q100 v.2	20151216	Product data sheet	-	HEF4070B_Q100 v.1
Modifications:	Type number HEF4070BP-Q100 (SOT27-1) removed.			
HEF4070B_Q100 v.1	20140522	Product data sheet	-	-

15. Legal information

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.

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

1. General description..... 1

2. Features and benefits..... 1

3. Applications..... 1

4. Ordering information..... 1

5. Functional diagram.....2

6. Pinning information.....2

6.1. Pinning.....2

6.2. Pin description..... 2

7. Functional description..... 3

8. Limiting values..... 3

9. Recommended operating conditions.....3

10. Static characteristics.....4

11. Dynamic characteristics.....5

11.1. Waveforms..... 5

12. Package outline..... 7

13. Abbreviations..... 8

14. Revision history.....8

15. Legal information.....9

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For sales office addresses, please send an email to: salesaddresses@nexperia.com

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