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Team Nexperia

HEF4043B-Q100

Quad R/S latch with 3-state outputs

Rev. 1 — 15 July 2013 Product data sheet

1. General description

The HEF4043B-Q100 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).

The nR and nS inputs determine the latch output (nQ) when OE is HIGH (see 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.

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
- Standardized symmetrical output characteristics
- ESD protection:
  - MIL-STD-833, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- 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
HEF4043BT-Q100	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

5. Functional diagram

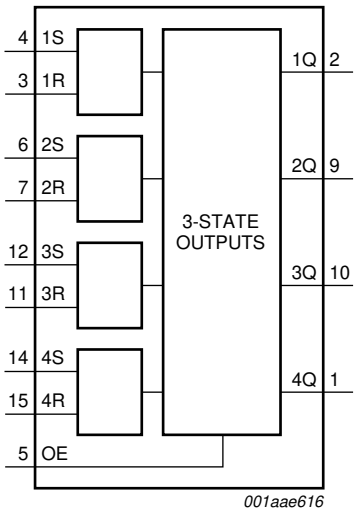


Fig 1. Functional diagram

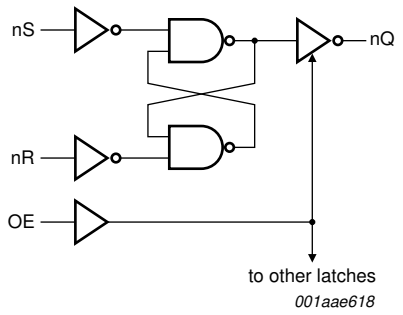


Fig 2. Logic diagram for one latch

6. Pinning information

6.1 Pinning

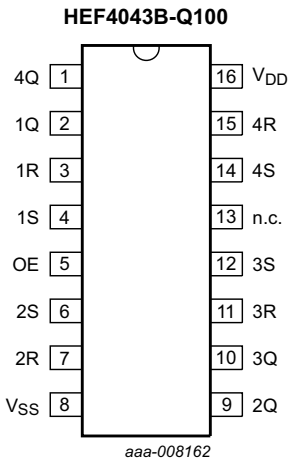


Fig 3. Pin configuration

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	[1]	-	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	-	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
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).

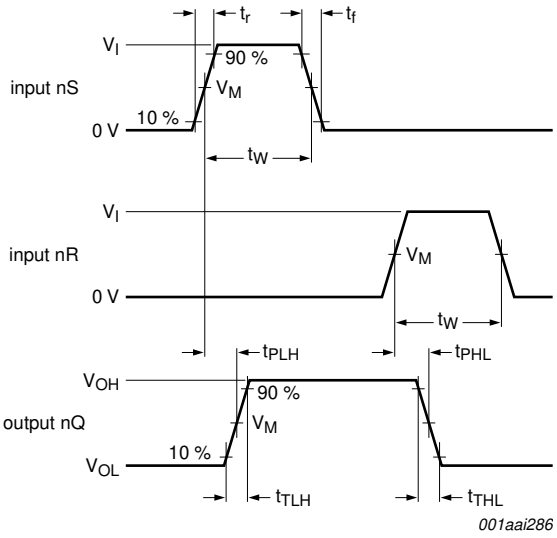
[2] t_t is the same as t_{THL} and t_{TLH}.

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



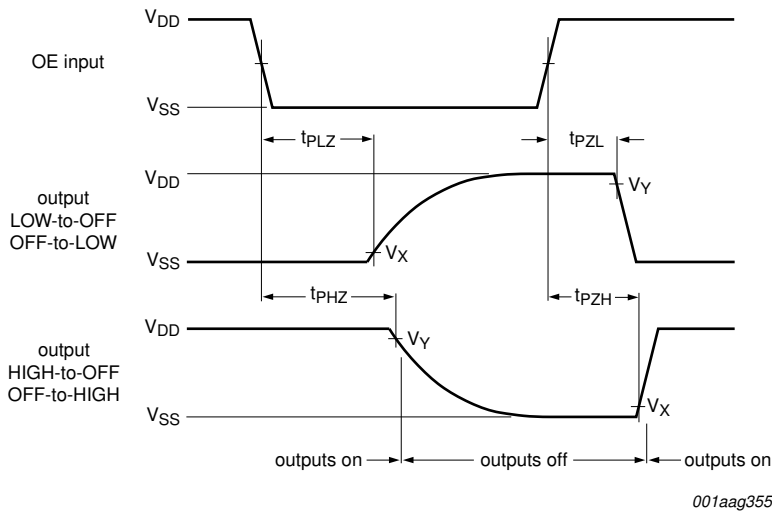
t_r and t_f are the input rise and fall times.

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

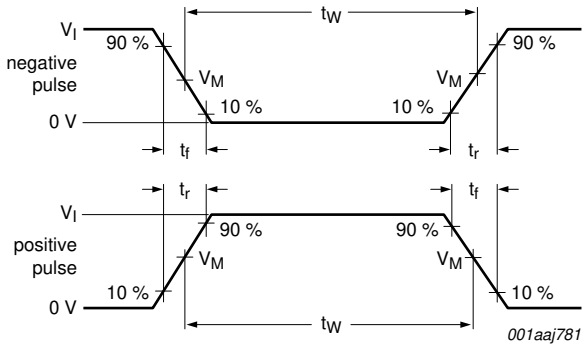


Measurement points are given in Table 9.

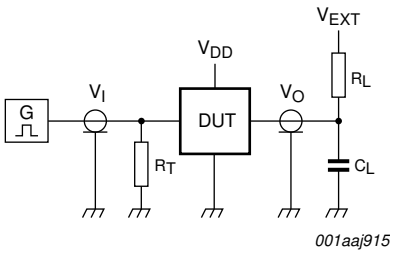
Fig 5. Output enable (OE) to latch output (nQ) enable time (t_{PZL} and t_{PZH}) and disable time (t_{PLZ} and t_{PHZ})

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.

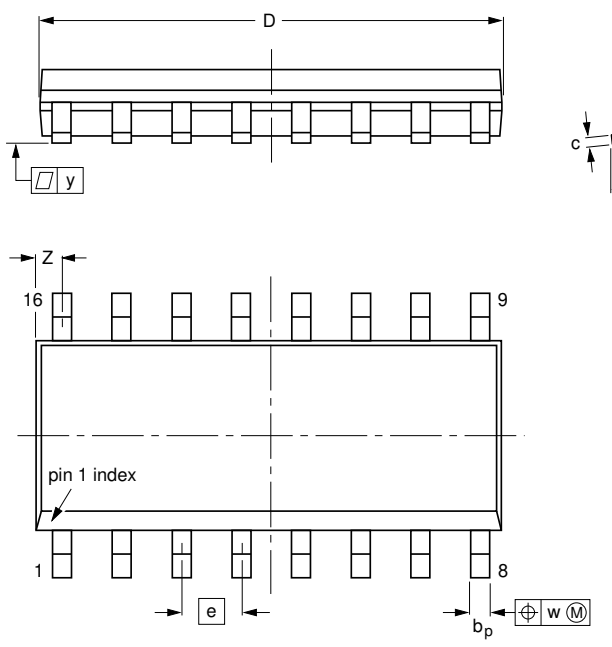
Fig 6. Test circuit for measuring switching times

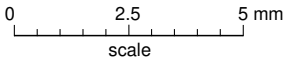
Table 10. Test data

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

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 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 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~~ 03-02-19

Fig 7. Package outline SOT109-1 (SO16)

14. Abbreviations

Table 11. Abbreviations

Acronym	Description
HBM	Human Body Model
ESD	ElectroStatic Discharge
MM	Machine Model
MIL	Military

15. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4043B_Q100 v.1	20130715	Product data sheet	-	-

16. Legal information

16.1 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.
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18. Contents

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Document identifier: HEF4043B_Q100