74HC73

Dual JK flip-flop with reset; negative-edge trigger Rev. 8 — 26 March 2024 Product data sheet

1. General description

The 74HC73 is a dual negative edge triggered JK flip-flop with individual J, K, clock ($n\overline{CP}$) and reset ($n\overline{R}$) inputs and complementary nQ and n \overline{Q} outputs. The J and K inputs must be stable one set-up time prior to the HIGH-to-LOW clock transition for predictable operation. ($n\overline{R}$) is asynchronous, when LOW it overrides the clock and data inputs, forcing the nQ output LOW and the $n\overline{Q}$ output HIGH. Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

2. Features and benefits

- · CMOS low-power dissipation
- Wide supply voltage range from 2.0 to 6.0 V
- · High noise immunity
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- · Complies with JEDEC standards
 - JESD8C (2.7 V to 3.6 V)
 - JESD7A (2.0 V to 6.0 V)
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Specified from -40 °C to +80 °C and from -40 °C to +125 °C

3. Ordering information

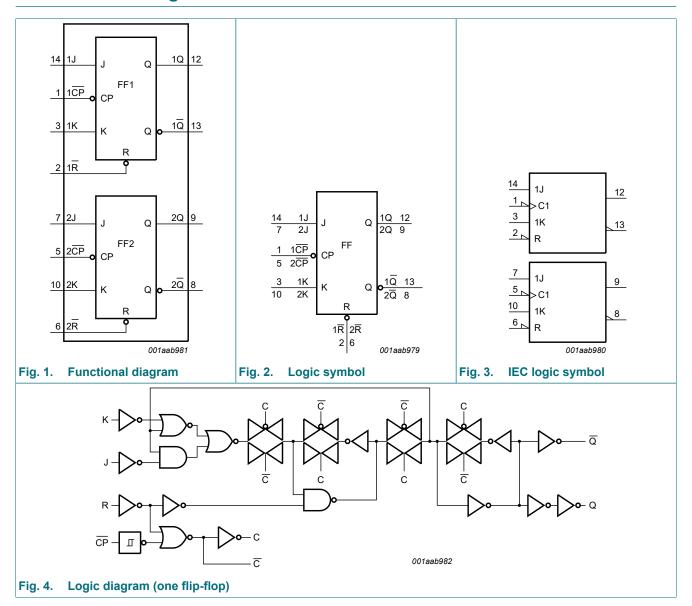
Table 1. Ordering information

Type number	Package	ackage					
	Temperature range	Name	Description	Version			
74HC73D	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1			
74HC73PW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1			



Dual JK flip-flop with reset; negative-edge trigger

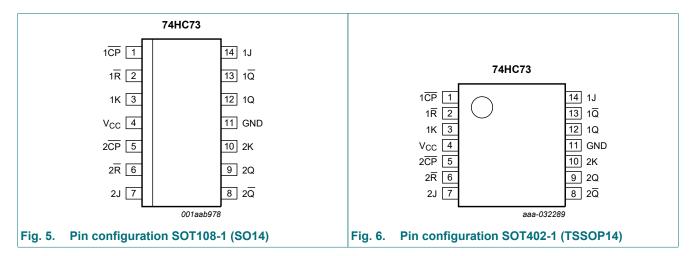
4. Functional diagram



Dual JK flip-flop with reset; negative-edge trigger

5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1CP, 2CP	1, 5	clock input (HIGH-to-LOW edge-triggered); also referred to as nCP
1R, 2R	2, 6	asynchronous reset input (active LOW); also referred to as nR
1K, 2K	3, 10	synchronous K input; also referred to as nK
V _{CC}	4	positive supply voltage
GND	11	ground (0 V)
1Q, 2Q	12, 9	true output; also referred to as nQ
1Q, 2Q	13, 8	complement output; also referred to as nQ
1J, 2J	14, 7	synchronous J input; also referred to as nJ

6. Functional description

Table 3. Function table

H = HIGH voltage level; h = HIGH voltage level one set-up time prior to the HIGH-to-LOW clock transition;

L = LOW voltage level; I = LOW voltage level one set-up time prior to the HIGH-to-LOW clock transition;

q = state of referenced output one set-up time prior to the HIGH-to-LOW clock transition;

 $X = don't care; \downarrow = HIGH-to-LOW clock transition.$

Input				Output		Operating mode	
nR	nCP	nJ	nK	nQ	nQ		
L	Х	Х	X	L	Н	asynchronous reset	
Н	\	h	h	q	q	toggle	
Н	\	I	h	L	Н	load 0 (reset)	
Н	\	h	I	Н	L	load 1 (set)	
Н	\	I	I	q	q	hold (no change)	

Dual JK flip-flop with reset; negative-edge trigger

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V _{CC}	supply voltage		-0.5	+7.0	V
I _{IK}	input clamping current	$V_1 < -0.5 \text{ V or } V_1 > V_{CC} + 0.5 \text{ V}$ [1]	-	±20	mA
I _{OK}	output clamping current	$V_O < -0.5 \text{ V or } V_O > V_{CC} + 0.5 \text{ V}$ [1]	-	±20	mA
Io	output current	$V_{O} = -0.5 \text{ V to } V_{CC} + 0.5 \text{ V}$	-	±25	mA
I _{CC}	supply current		-	50	mA
I _{GND}	ground current		-50	-	mA
T _{stg}	storage temperature		-65	+150	°C
P _{tot}	total power dissipation	$T_{amb} = -40 ^{\circ}\text{C} \text{ to } +125 ^{\circ}\text{C}$ [2]	-	500	mW

^[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
V _{CC}	supply voltage		2.0	5.0	6.0	V
VI	input voltage		0	-	V _{CC}	V
V _O	output voltage		0	-	V _{CC}	V
T _{amb}	ambient temperature		-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V _{CC} = 2.0 V	-	-	625	ns/V
		V _{CC} = 4.5 V	-	1.67	139	ns/V
		V _{CC} = 6.0 V	-	-	83	ns/V

9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		25 °C		-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Тур	Max	Min	Max	Min	Max	
V_{IH}	HIGH-level	V _{CC} = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
	input voltage	V _{CC} = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V _{CC} = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
V _{IL}	LOW-level	V _{CC} = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
	input voltage	V _{CC} = 4.5 V	-	2.1	1.35	-	1.35	_	1.35	V
		V _{CC} = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V

^[2] For SOT108-1 (SO14) package: P_{tot} derates linearly with 10.1 mW/K above 100 °C. For SOT402-1 (TSSOP14) package: P_{tot} derates linearly with 7.3 mW/K above 81 °C.

Dual JK flip-flop with reset; negative-edge trigger

Symbol	Parameter	Conditions		25 °C		-40 °C to	o +85 °C	-40 °C to +125 °C		Unit
			Min	Тур	Max	Min	Max	Min	Max	
V _{OH}	HIGH-level	V _I = V _{IH} or V _{IL}								
	output voltage	I _O = -20 μA; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I _O = -20 μA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -20 μA; V _{CC} = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I _O = -4 mA; V _{CC} = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I_{O} = -5.2 mA; V_{CC} = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V
V _{OL}	LOW-level	V _I = V _{IH} or V _{IL}								
	output voltage	I_{O} = 20 μ A; V_{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		$I_{O} = 20 \mu A; V_{CC} = 6.0 V$	-	0	0.1	-	0.1	-	0.1	V
		I _O = 4 mA; V _{CC} = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I_{O} = 5.2 mA; V_{CC} = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
II	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0 \text{ V}$	-	-	±0.1	-	±1.0	-	±1.0	μA
I _{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 6.0 \text{ V}$	-	-	4.0	-	40.0	-	80.0	μA
Cı	input capacitance		-	3.5	-	-	-	-	-	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

GND (ground = 0 V); C_L = 50 pF unless otherwise specified; for test circuit, see Fig. 9

Symbol	Parameter	Conditions		25 °C		-40 °C to	o +85 °C		°C to 5 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	
t _{pd}	propagation	nCP to nQ; see Fig. 7 [1]								
	delay	V _{CC} = 2.0 V	-	52	160	-	200	-	240	ns
		V _{CC} = 4.5 V	-	19	32	-	40	-	48	ns
		V _{CC} = 6.0 V	-	15	27	-	34	-	41	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	16	-	-	-	-	-	ns
		nCP to nQ; see Fig. 7								
		V _{CC} = 2.0 V	-	52	160	-	200	-	240	ns
		V _{CC} = 4.5 V	-	19	32	-	40	-	48	ns
		V _{CC} = 6.0 V	-	15	27		34	-	41	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	16	-	-				ns
		nR to nQ, nQ; see Fig. 8								
		V _{CC} = 2.0 V	-	50	145	-	180	-	220	ns
		V _{CC} = 4.5 V	-	18	29	-	36	-	44	ns
		V _{CC} = 6.0 V	-	14	25		31	-	38	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$	-	15	-	-	-	-	-	ns

Dual JK flip-flop with reset; negative-edge trigger

Symbol	Parameter	Conditions		25 °C		-40 °C to	o +85 °C	-40 ° +12		Unit
			Min	Тур	Max	Min	Max	Min	Max	
t _t	transition	nQ, nQ; see <u>Fig. 7</u> [2]								
	time	V _{CC} = 2.0 V	-	19	75	-	95	-	110	ns
		V _{CC} = 4.5 V	-	7	15	-	19	-	22	ns
		V _{CC} = 6.0 V	-	6	13		16	-	19	ns
t _W	pulse width	nCP input, HIGH or LOW; see Fig. 7								
		V _{CC} = 2.0 V	80	22	-	100		120	-	ns
		V _{CC} = 4.5 V	16	8	-	20	-	24	-	ns
		V _{CC} = 6.0 V	14	6	-	17	-	20		ns
		nR input, HIGH or LOW; see Fig. 8								
		V _{CC} = 2.0 V	80	22	-	100		120	-	ns
		V _{CC} = 4.5 V	16	8	-	20	-	24	-	ns
		V _{CC} = 6.0 V	14	6	-	17	-	20		ns
t _{rec}	recovery time	nR to nCP; see Fig. 8								
		V _{CC} = 2.0 V	80	22	-	100		120	-	ns
		V _{CC} = 4.5 V	16	8	-	20	-	24	-	ns
		V _{CC} = 6.0 V	14	6	-	17	-	20		ns
t _{su}	set-up time	nJ, nK to nCP; see Fig. 7								
		V _{CC} = 2.0 V	80	22	-	100		120	-	ns
		V _{CC} = 4.5 V	16	8	-	20	-	24	-	ns
		V _{CC} = 6.0 V	14	6	-	17	-	20		ns
t _h	hold time	nJ, nK to nCP; see Fig. 7								
		V _{CC} = 2.0 V	3	-8	-	3		3	-	ns
		V _{CC} = 4.5 V	3	-3	-	3	-	3	-	ns
		V _{CC} = 6.0 V	3	-2	-	3	-	3		ns
f _{max}	maximum	nCP input; see Fig. 7								
	frequency	V _{CC} = 2.0 V	6.0	23	-	4.8		4.0	-	MHz
		V _{CC} = 4.5 V	30	70	-	24	-	20	-	MHz
		V _{CC} = 6.0 V	35	83	-	28	-	24	-	MHz
		V _{CC} = 5.0 V; C _L = 15 pF	-	77	-		-		-	MHz
C _{PD}	power dissipation capacitance	per flip-flop; V_I = GND to V_{CC} [3]	-	30	-	-	-	-	-	pF

- [1] t_{pd} is the same as t_{PHL} , t_{PLH} . [2] t_t is the same as t_{THL} , t_{TLH} . [3] C_{PD} is used to determine the dynamic power dissipation (P_D in μ W). $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$ where: f_i = input frequency in MHz;

f_o = output frequency in MHz;

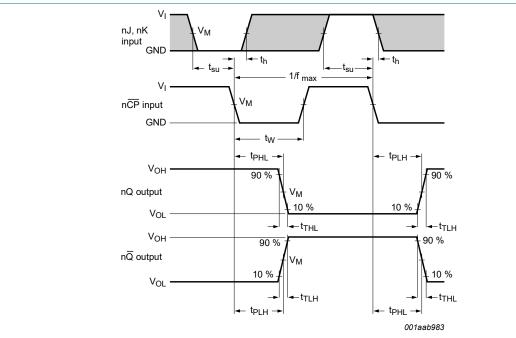
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching; $\sum (C_L \times V_{CC}^2 \times f_0) = \text{sum of outputs.}$

Dual JK flip-flop with reset; negative-edge trigger

10.1. Waveforms and test circuit

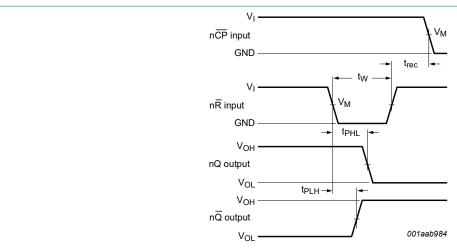


Measurement points are given in Table 8.

The shaded areas indicate when the input is permitted to change for predictable output performance.

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

Fig. 7. Waveforms showing the clock ($n\overline{CP}$) to output (nQ, $n\overline{Q}$) propagation delays, the clock pulse width, the J and K to $n\overline{CP}$ set-up and hold times, the output transition times and the maximum clock frequency



Measurement points are given in <u>Table 8</u>.

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

Fig. 8. Waveforms showing the reset ($n\overline{R}$) input to output (nQ, $n\overline{Q}$) propagation delays and the reset pulse width and the $n\overline{R}$ to $n\overline{CP}$ removal time

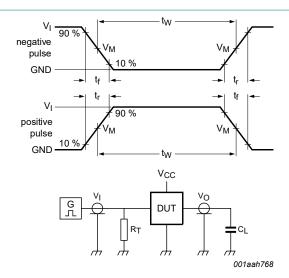
Table 8. Measurement points

Input		Output
V _I	V _M	V _M
V _{CC}	0.5V _{CC}	0.5V _{CC}

74HC73

Product data sheet

Dual JK flip-flop with reset; negative-edge trigger



Test data is given in Table 9.

Definitions for test circuit:

 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. 9. Test circuit for measuring switching times

Table 9. Test data

Input		Load
V _I	t _r , t _f	CL
V _{CC}	6 ns	15 pF, 50 pF

Dual JK flip-flop with reset; negative-edge trigger

11. Package outline

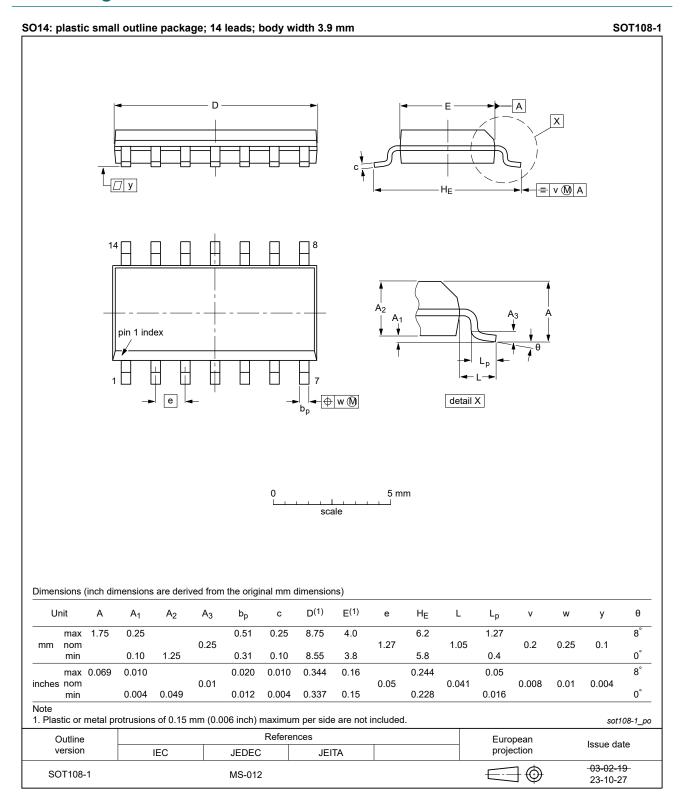


Fig. 10. Package outline SOT108-1 (SO14)

Dual JK flip-flop with reset; negative-edge trigger

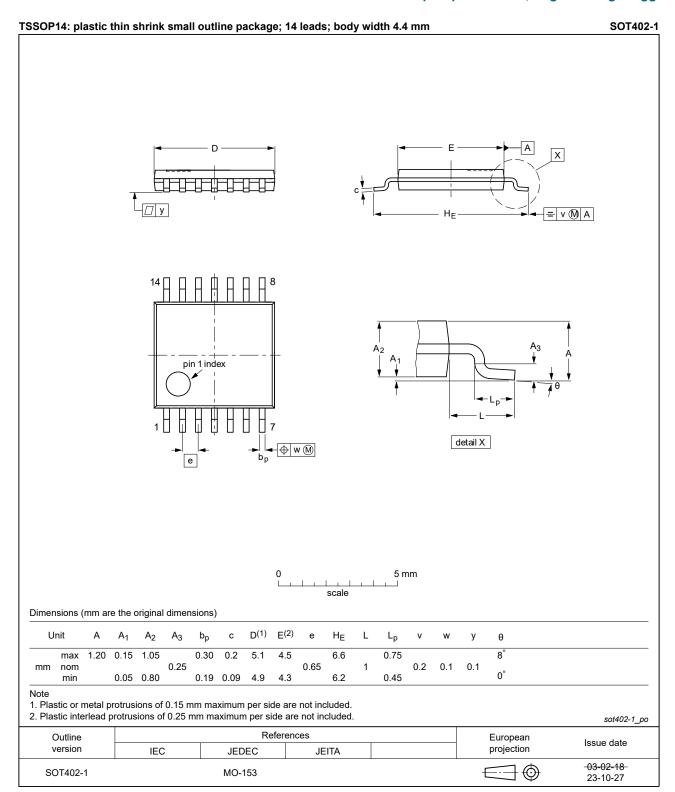


Fig. 11. Package outline SOT402-1 (TSSOP14)

Dual JK flip-flop with reset; negative-edge trigger

12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
НВМ	Human Body Model

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes		
74HC73 v.8	20240326	Product data sheet	-	74HC73 v.7		
Modifications:	and MO-15	 Fig. 10, Fig. 11: Aligned SO and TSSOP package outline drawings to JEDEC MS-012 and MO-153. Section 2: ESD specification updated according to the latest JEDEC standard. 				
74HC73 v.7	20200913	Product data sheet	-	74HC73 v.6		
Modifications:	Type number	Type number 74HC73DB (SOT337-1/SSOP14) removed.				
74HC73 v.6	20201204	Product data sheet	-	74HC73 v.5		
Modifications:	guidelines o • Legal texts	 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. Table 4: Derating values for P_{tot} total power dissipation updated. 				
74HC73 v.5	20151202	Product data sheet	-	74HC73 v.4		
Modifications:	Type number	Type number 74HC73N (SOT27-1) removed.				
74HC73 v.4	20080319	Product data sheet	-	74HC73 v.3		
Modifications:	guidelines of Legal texts Quick reference	 The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate. Quick reference data incorporated into Section 9 and Section 10. Section 8 t_r, t_f converted to Δt/ΔV. 				
74HC73 v.3	20041112	Product data sheet	-	74HC_HCT73_CNV v.2		
74HC_HCT73_CNV v.2	December 1990	Product specification	-	-		

14. 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.

- Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
- 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 https://www.nexperia.com.

Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Nexperia sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Nexperia and its customer, unless Nexperia and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Nexperia product is deemed to offer functions and qualities beyond those described in the Product data sheet.

Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, Nexperia does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Nexperia takes no responsibility for the content in this document if provided by an information source outside of Nexperia.

In no event shall Nexperia be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, Nexperia's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of Nexperia.

Right to make changes — Nexperia reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — Nexperia products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an Nexperia product can reasonably be expected to result in personal

Dual JK flip-flop with reset; negative-edge trigger

injury, death or severe property or environmental damage. Nexperia and its suppliers accept no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Nexperia products, and Nexperia accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Nexperia product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Nexperia does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Nexperia products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Nexperia does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nexperia.com/profile/terms, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Nexperia hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Nexperia products by sustained.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Non-automotive qualified products — Unless this data sheet expressly states that this specific Nexperia product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Nexperia accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without Nexperia's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond Nexperia's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies Nexperia for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond Nexperia's standard warranty and Nexperia's product specifications.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

74HC73

All information provided in this document is subject to legal disclaimers.

© Nexperia B.V. 2024. All rights reserved

Dual JK flip-flop with reset; negative-edge trigger

Contents

1. General description	1
2. Features and benefits	1
3. Ordering information	1
4. Functional diagram	2
5. Pinning information	3
5.1. Pinning	3
5.2. Pin description	3
6. Functional description	3
7. Limiting values	4
8. Recommended operating conditions	4
9. Static characteristics	4
10. Dynamic characteristics	5
10.1. Waveforms and test circuit	7
11. Package outline	g
12. Abbreviations	11
13. Revision history	11
14. Legal information	

For more information, please visit: http://www.nexperia.com For sales office addresses, please send an email to: salesaddresses@nexperia.com Date of release: 26 March 2024

[©] Nexperia B.V. 2024. All rights reserved

单击下面可查看定价,库存,交付和生命周期等信息

>>Nexperia(安世)