

# 74HC132; 74HCT132

## Quad 2-input NAND Schmitt trigger

Rev. 6 — 16 July 2019

Product data sheet

### 1. General description

The 74HC132; 74HCT132 is a quad 2-input NAND gate with Schmitt-trigger inputs. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ . Schmitt trigger inputs transform slowly changing input signals into sharply defined jitter-free output signals.

### 2. Features and benefits

- Complies with JEDEC standard no. 7A
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from  $-40\text{ °C}$  to  $+85\text{ °C}$  and from  $-40\text{ °C}$  to  $+125\text{ °C}$

### 3. Applications

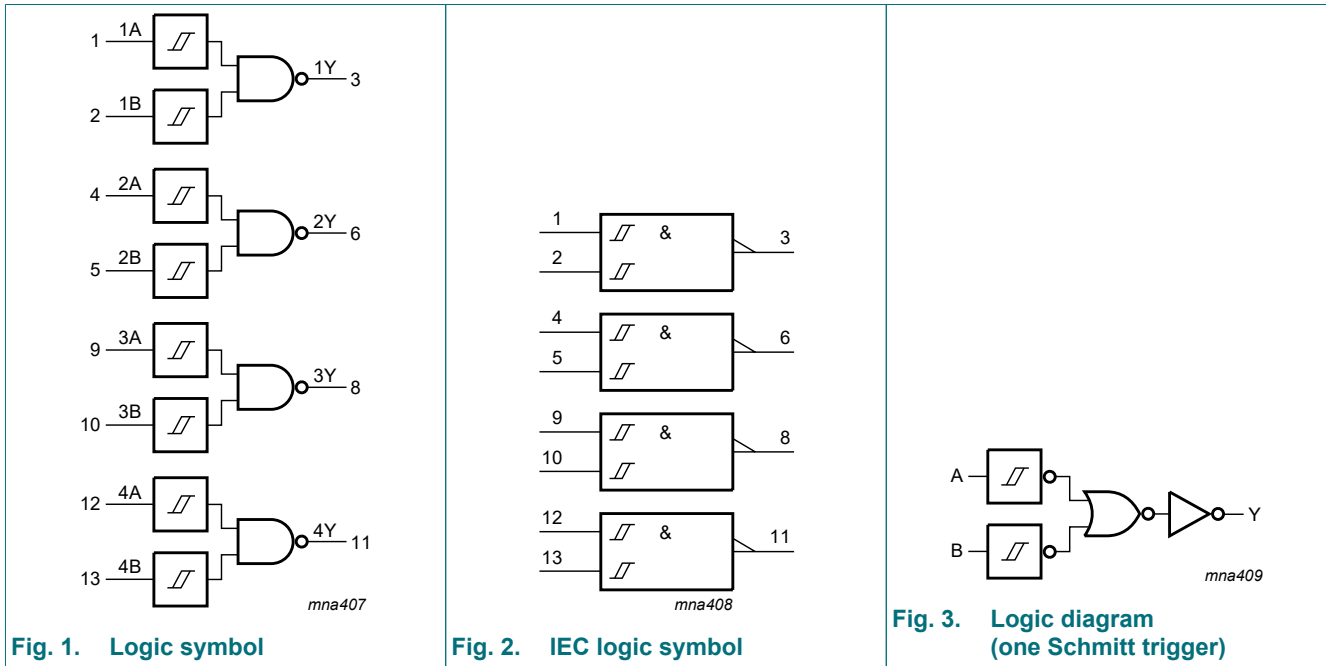
- Wave and pulse shapers
- Astable multivibrators
- Monostable multivibrators

### 4. Ordering information

Table 1. Ordering information

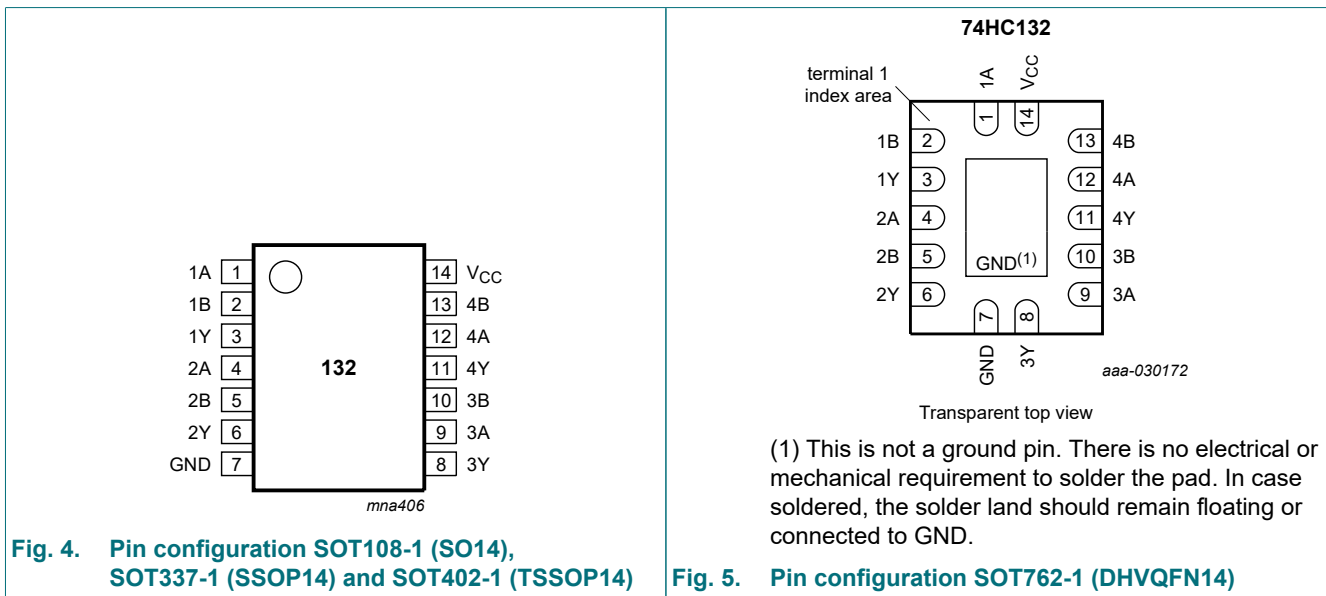
Type number	Package			
	Temperature range	Name	Description	Version
74HC132D	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HCT132D				
74HC132DB	-40 °C to +125 °C	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	SOT337-1
74HCT132DB				
74HC132PW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74HCT132PW				
74HC132BQ	-40 °C to +125 °C	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 × 3 × 0.85 mm	SOT762-1

### 5. Functional diagram



### 6. Pinning information

#### 6.1. Pinning



## 6.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1A to 4A	1, 4, 9, 12	data input
1B to 4B	2, 5, 10, 13	data input
1Y to 4Y	3, 6, 8, 11	data output
GND	7	ground (0 V)
V <sub>CC</sub>	14	supply voltage

## 7. Functional description

Table 3. Function table [1]

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

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

## 8. 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 <sub>CC</sub>	supply voltage		-0.5	+7	V
I <sub>IK</sub>	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ [1]	-	±20	mA
I <sub>OK</sub>	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ [1]	-	±20	mA
I <sub>O</sub>	output current	$-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$	-	±25	mA
I <sub>CC</sub>	supply current		-	50	mA
I <sub>GND</sub>	ground current		-50	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	[2]	-	500	mW

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

[2] For SOT108-1 (SO14) package: P<sub>tot</sub> derates linearly with 10.1 mW/K above 100 °C.  
 For SOT337-1 (SSOP14) packages: P<sub>tot</sub> derates linearly with 7.3 mW/K above 81 °C.  
 For SOT402-1 (TSSOP14) packages: P<sub>tot</sub> derates linearly with 7.3 mW/K above 81 °C.  
 For SOT762-1 (DHVQFN14) packages: P<sub>tot</sub> derates linearly with 9.6 mW/K above 98 °C.

## 9. Recommended operating conditions

**Table 5. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC132			74HCT132			Unit
			Min	Typ	Max	Min	Typ	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V <sub>I</sub>	input voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
V <sub>O</sub>	output voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	-40	+25	+125	°C

## 10. 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	Typ	Max	Min	Max	Min	Max	
<b>74HC132</b>										
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub>								
		I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub>								
		I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	±0.1	-	±1.0	-	±1.0	µA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V	-	-	2.0	-	20	-	40	µA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF
<b>74HCT132</b>										
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = -20 µA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4.0 mA	3.98	4.32	-	3.84	-	3.7	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = 20 µA;	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA;	-	0.15	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±0.1	-	±1.0	-	±1.0	µA

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	-	2.0	-	20	-	40	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other inputs at V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 4.5 V to 5.5 V	-	30	108	-	135	-	147	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

## 11. Dynamic characteristics

Table 7. Dynamic characteristics

GND = 0 V; C<sub>L</sub> = 50 pF; for test circuit see Fig. 7.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HC132</b>										
t <sub>pd</sub>	propagation delay	nA, nB to nY; see Fig. 6 [1]								
		V <sub>CC</sub> = 2.0 V	-	36	125	-	155	-	190	ns
		V <sub>CC</sub> = 4.5 V	-	13	25	-	31	-	38	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF	-	11	-	-	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	-	10	21	-	26	-	32	ns
t <sub>t</sub>	transition time	see Fig. 6 [2]								
		V <sub>CC</sub> = 2.0 V	-	19	75	-	95	-	110	ns
		V <sub>CC</sub> = 4.5 V	-	7	15	-	19	-	22	ns
		V <sub>CC</sub> = 6.0 V	-	6	13	-	16	-	19	ns
C <sub>PD</sub>	power dissipation capacitance	per package; V <sub>I</sub> = GND to V <sub>CC</sub> [3]	-	24	-	-	-	-	-	pF
<b>74HCT132</b>										
t <sub>pd</sub>	propagation delay	nA, nB to nY; see Fig. 6 [1]								
		V <sub>CC</sub> = 4.5 V	-	20	33	-	41	-	50	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF	-	17	-	-	-	-	-	ns
t <sub>t</sub>	transition time	V <sub>CC</sub> = 4.5 V; see Fig. 6 [2]	-	7	15	-	19	-	22	ns
C <sub>PD</sub>	power dissipation capacitance	per package; V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V [3]	-	20	-	-	-	-	-	pF

[1] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.

[2] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.

[3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

C<sub>L</sub> = output load capacitance in pF;

V<sub>CC</sub> = supply voltage in V;

N = number of inputs switching;

∑ (C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs.

11.1. Waveforms and test circuit

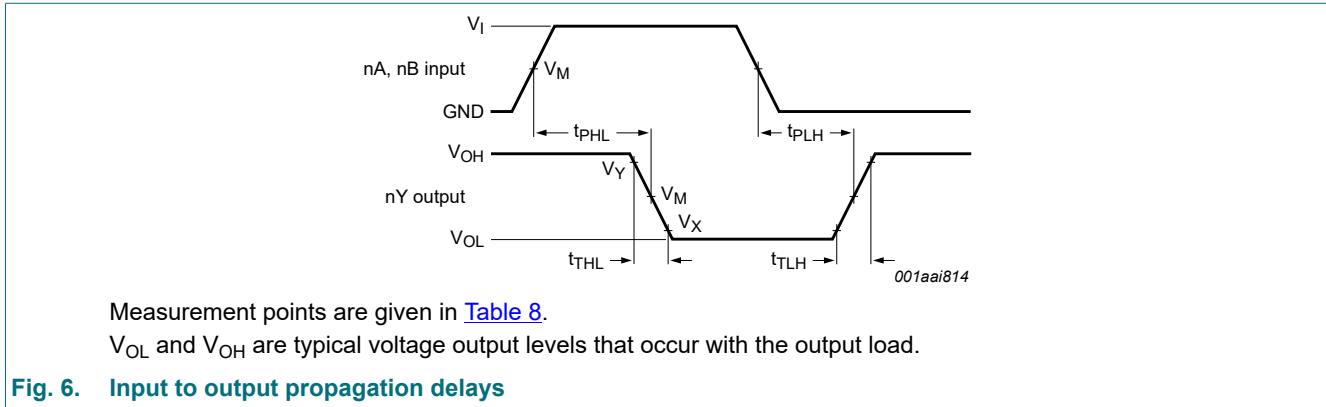


Table 8. Measurement points

Type	Input	Output		
	$V_M$	$V_M$	$V_X$	$V_Y$
74HC132	$0.5V_{CC}$	$0.5V_{CC}$	$0.1V_{CC}$	$0.9V_{CC}$
74HCT132	1.3 V	1.3 V	$0.1V_{CC}$	$0.9V_{CC}$

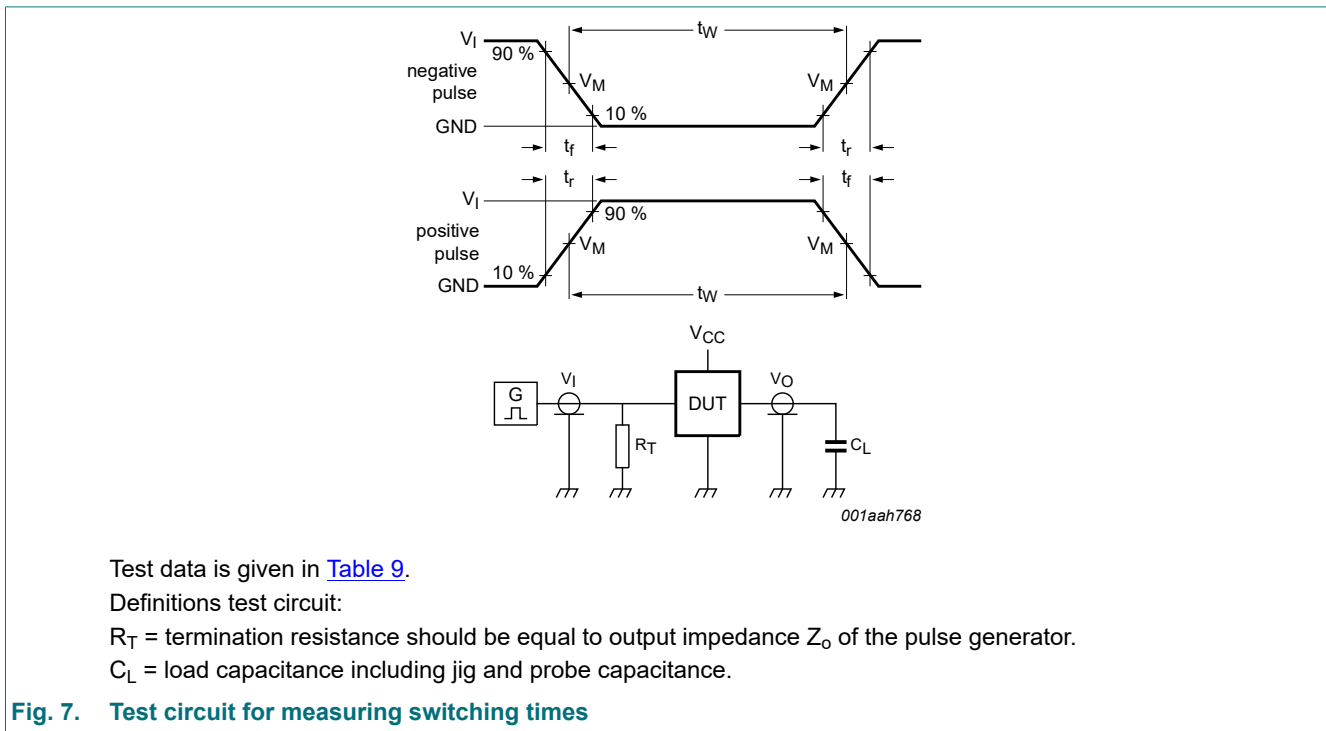


Table 9. Test data

Type	Input		Load	Test
	$V_I$	$t_r, t_f$	$C_L$	
74HC132	$V_{CC}$	6.0 ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$
74HCT132	3.0 V	6.0 ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$

## 12. Transfer characteristics

**Table 10. Transfer characteristics**

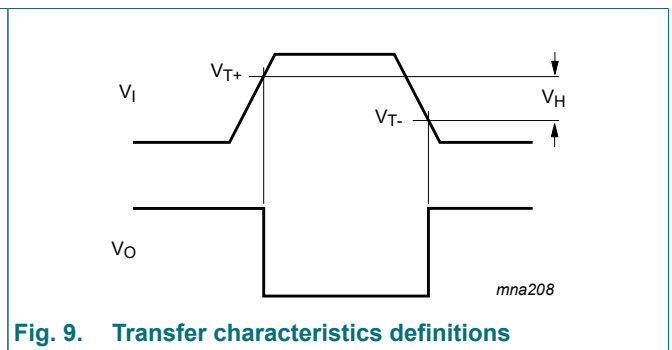
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for waveforms see Fig. 8 till Fig. 11.

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +85 °C		T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HC132</b>										
V <sub>T+</sub>	positive-going threshold voltage	V <sub>CC</sub> = 2.0 V	0.7	1.18	1.5	0.7	1.5	0.7	1.5	V
		V <sub>CC</sub> = 4.5 V	1.7	2.38	3.15	1.7	3.15	1.7	3.15	V
		V <sub>CC</sub> = 6.0 V	2.1	3.14	4.2	2.1	4.2	2.1	4.2	V
V <sub>T-</sub>	negative-going threshold voltage	V <sub>CC</sub> = 2.0 V	0.3	0.63	1.0	0.3	1.0	0.3	1.0	V
		V <sub>CC</sub> = 4.5 V	0.9	1.67	2.2	0.9	2.2	0.9	2.2	V
		V <sub>CC</sub> = 6.0 V	1.2	2.26	3.0	1.2	3.0	1.2	3.0	V
V <sub>H</sub>	hysteresis voltage	V <sub>CC</sub> = 2.0 V	0.2	0.55	1.0	0.2	1.0	0.2	1.0	V
		V <sub>CC</sub> = 4.5 V	0.4	0.71	1.4	0.4	1.4	0.4	1.4	V
		V <sub>CC</sub> = 6.0 V	0.6	0.88	1.6	0.6	1.6	0.6	1.6	V
<b>74HCT132</b>										
V <sub>T+</sub>	positive-going threshold voltage	V <sub>CC</sub> = 4.5 V	1.2	1.41	1.9	1.2	1.9	1.2	1.9	V
		V <sub>CC</sub> = 5.5 V	1.4	1.59	2.1	1.4	2.1	1.4	2.1	V
V <sub>T-</sub>	negative-going threshold voltage	V <sub>CC</sub> = 4.5 V	0.5	0.85	1.2	0.5	1.2	0.5	1.2	V
		V <sub>CC</sub> = 5.5 V	0.6	0.99	1.4	0.6	1.4	0.6	1.4	V
V <sub>H</sub>	hysteresis voltage	V <sub>CC</sub> = 4.5 V	0.4	0.56	-	0.4	-	0.4	-	V
		V <sub>CC</sub> = 5.5 V	0.4	0.60	-	0.4	-	0.4	-	V

### 12.1. Transfer characteristics waveforms



**Fig. 8. Transfer characteristics**



**Fig. 9. Transfer characteristics definitions**

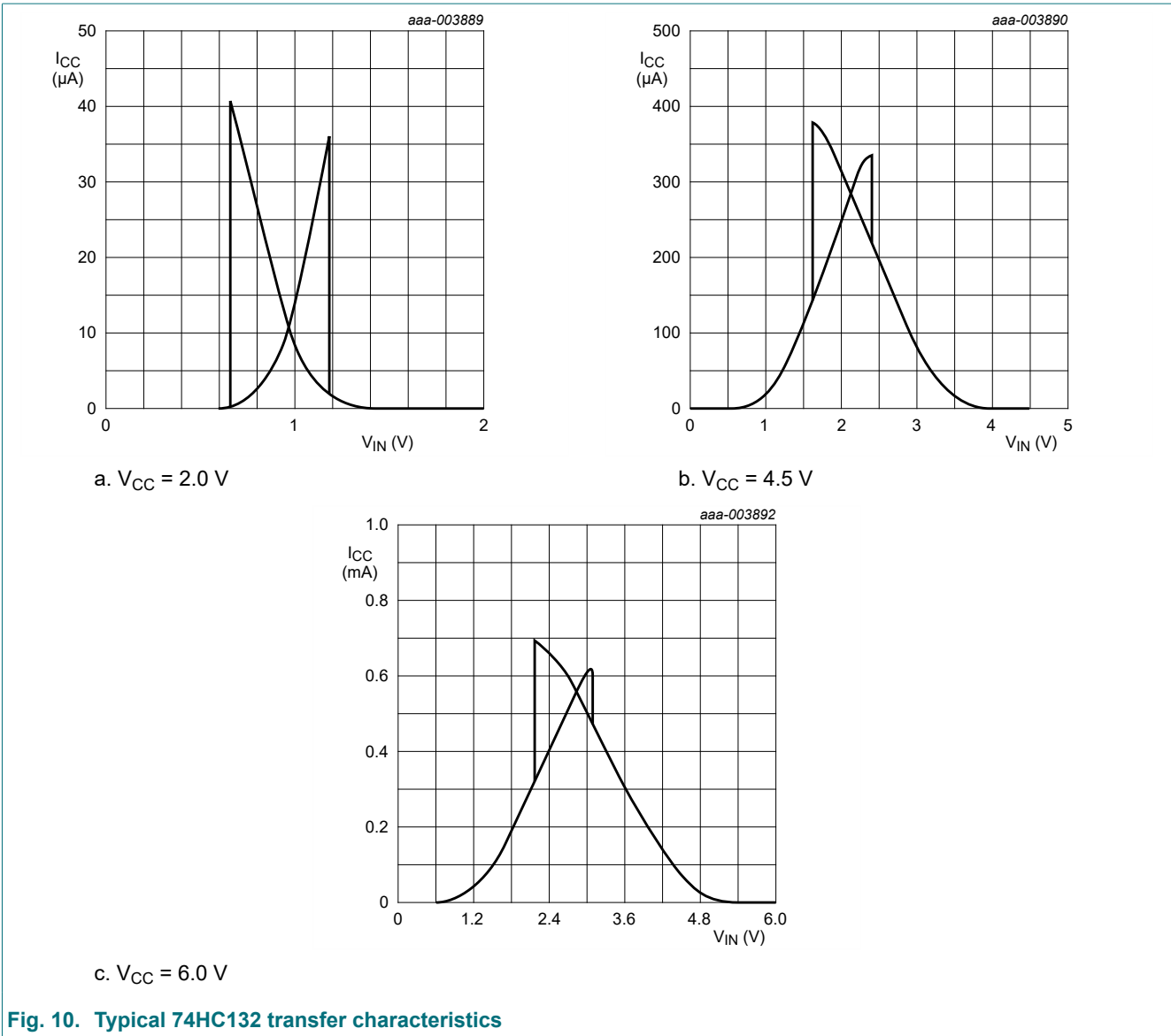


Fig. 10. Typical 74HC132 transfer characteristics

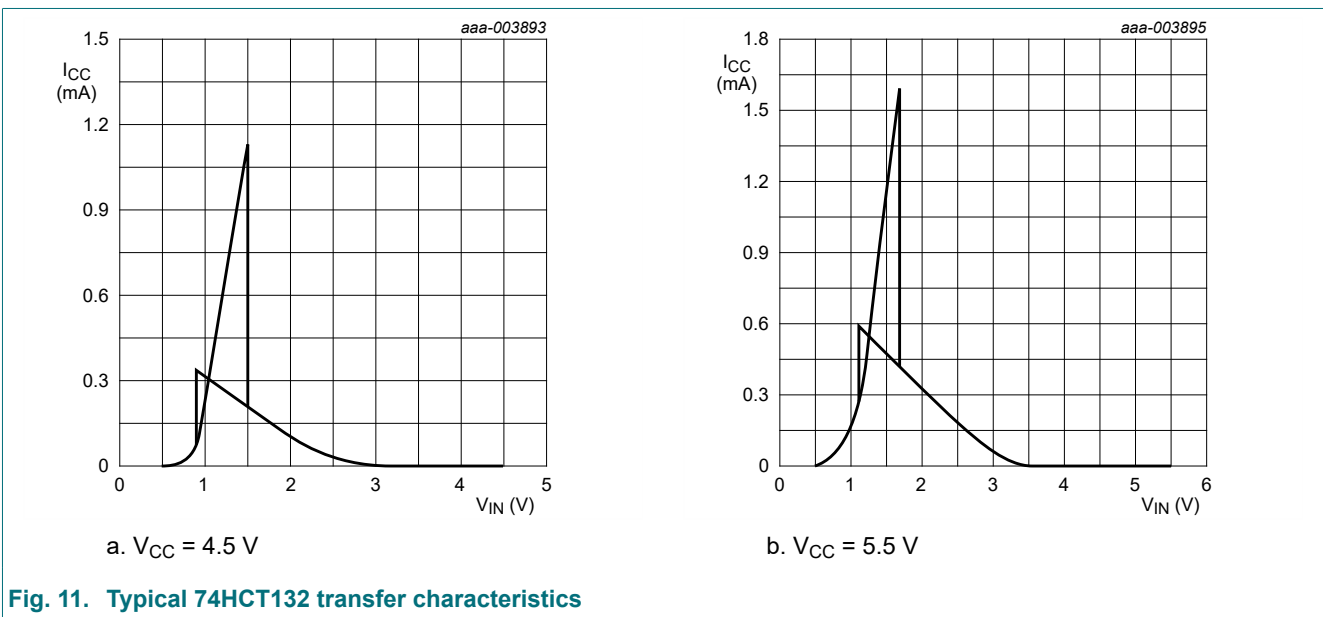


Fig. 11. Typical 74HCT132 transfer characteristics



### 13. Application information

The slow input rise and fall times cause additional power dissipation, this can be calculated using the following formula:

$$P_{add} = f_i \times (t_r \times \Delta I_{CC(AV)} + t_f \times \Delta I_{CC(AV)}) \times V_{CC} \text{ where:}$$

- $P_{add}$  = additional power dissipation ( $\mu\text{W}$ );
- $f_i$  = input frequency (MHz);
- $t_r$  = rise time (ns); 10 % to 90 %;
- $\Delta I_{CC(AV)}$  = average additional supply current ( $\mu\text{A}$ ).
- $t_f$  = fall time (ns); 90 % to 10 %;

Average  $\Delta I_{CC(AV)}$  differs with positive or negative input transitions, as shown in Fig. 12 and Fig. 13.

An example of a relaxation circuit using the 74HC132; 74HCT132 is shown in Fig. 14.



**Fig. 12. Average additional supply current as a function of  $V_{CC}$  for 74HC132; linear change of  $V_I$  between  $0.1V_{CC}$  to  $0.9V_{CC}$ .**



**Fig. 13. Average additional supply current as a function of  $V_{CC}$  for 74HCT132; linear change of  $V_I$  between  $0.1V_{CC}$  to  $0.9V_{CC}$ .**

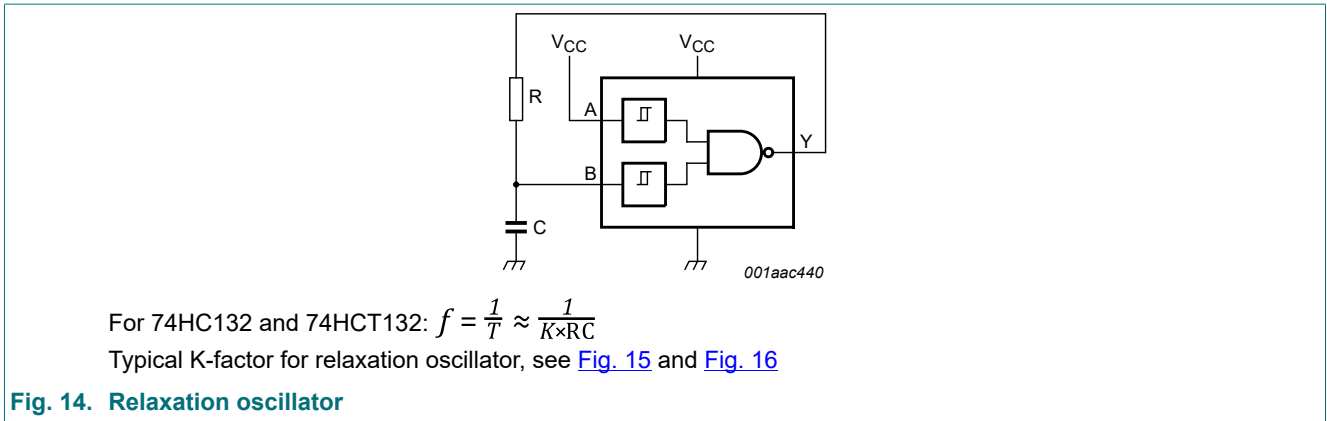


Fig. 14. Relaxation oscillator

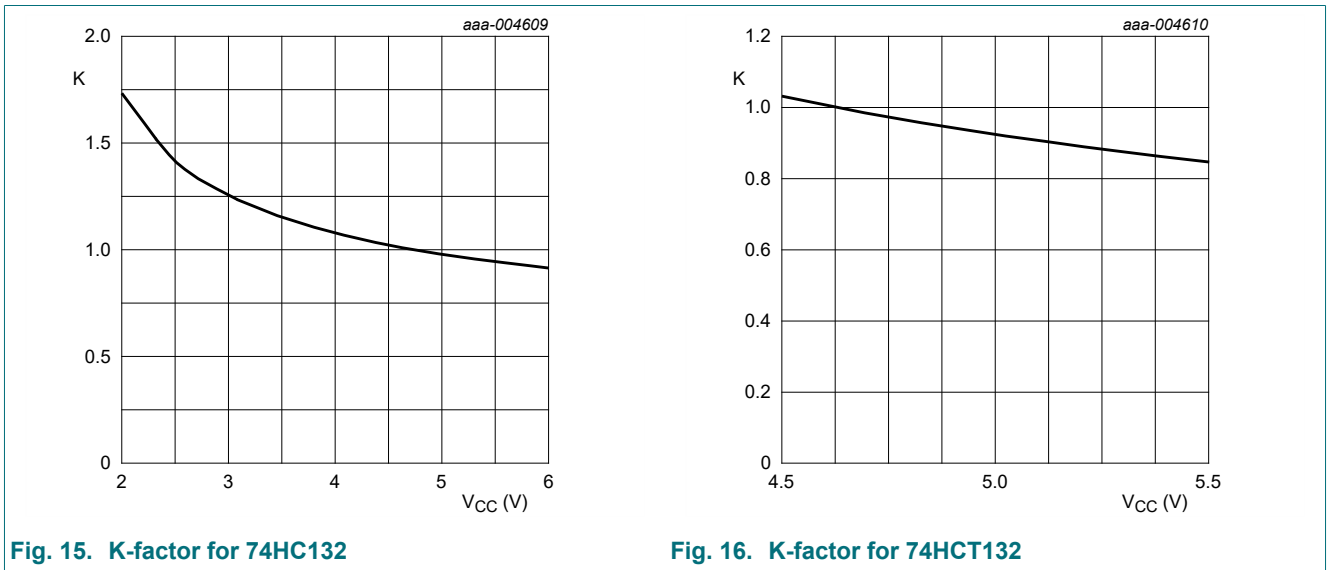


Fig. 15. K-factor for 74HC132

Fig. 16. K-factor for 74HCT132

14. Package outline

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

SOT108-1



Fig. 17. Package outline SOT108-1 (SO14)

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

SOT337-1

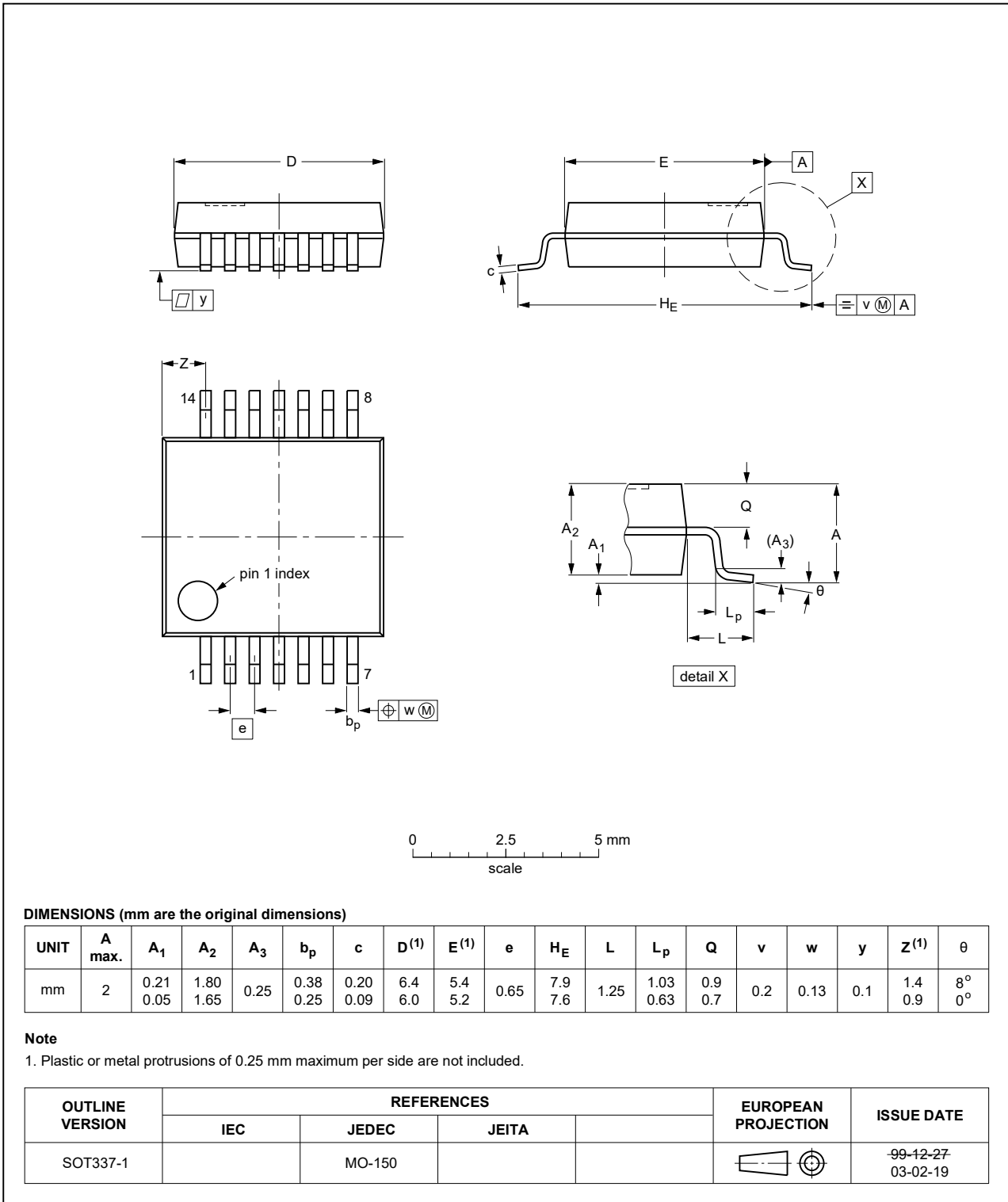


Fig. 18. Package outline SOT337-1 (SSOP14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



Fig. 19. Package outline SOT402-1 (TSSOP14)

DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm

SOT762-1



Fig. 20. Package outline SOT762-1 (DHVQFN14)

## 15. Abbreviations

Table 11. Abbreviations

Acronym	Description
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

## 16. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT132 v.6	20190716	Product data sheet	-	74HC_HCT132 v.5
Modifications:	<ul style="list-style-type: none"> <li>Type number 74HC132BQ (SOT762-1) added.</li> <li><a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation have changed.</li> </ul>			
74HC_HCT132 v.5	20180612	Product data sheet	-	74HC_HCT132 v.4
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>			
74HC_HCT132 v.4	20151201	Product data sheet	-	74HC_HCT132 v.3
Modifications:	<ul style="list-style-type: none"> <li>Type numbers 74HC132N and 74HCT132N (SOT27-1) removed.</li> </ul>			
74HC_HCT132 v.3	20120830	Product data sheet	-	74HC_HCT132_CNV v.2
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li><a href="#">Fig. 15</a> and <a href="#">Fig. 16</a> added (typical K-factor for relaxation oscillator).</li> </ul>			
74HC_HCT132_CNV v.2	19970826	Product specification	-	-

## 17. 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.

- [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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