74HC132; 74HCT132

Quad 2-input NAND Schmitt trigger

Rev. 3 — 30 August 2012 **Product data sheet**

1. General description

The 74HC132; 74HCT132 is a high-speed Si-gate CMOS device and is pin compatible with Low-power Schottky TTL (LSTTL). It is specified in compliance with JEDEC standard No. 7A

The 74HC132; 74HCT132 is a quad 2-input NAND gate with Schmitt trigger inputs. This device features reduced input threshold levels to allow interfacing to TTL logic levels. Inputs also include clamp diodes that enable 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.

The inputs switch at different points for positive and negative-going signals. The difference between the positive voltage V_{T+} and the negative voltage V_{T-} is defined as the input hysteresis voltage V_H.

2. Features and benefits

- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from –40 °C to +85 °C and from –40 °C to +125 °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
74HC132N	−40 °C to +125 °C	DIP14	plastic dual in-line package; 14 leads (300 mil)	SOT27-1
74HCT132N				
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				

5. Functional diagram

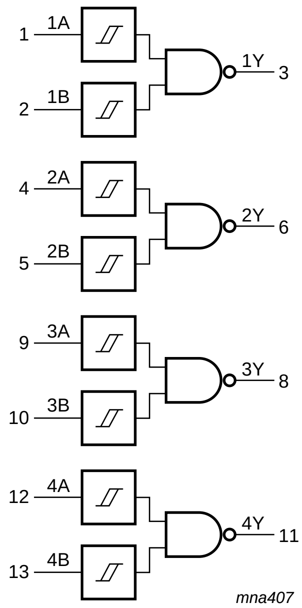


Fig 1. Logic symbol

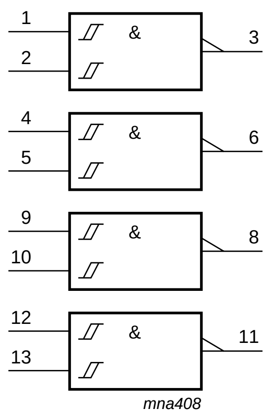


Fig 2. IEC logic symbol

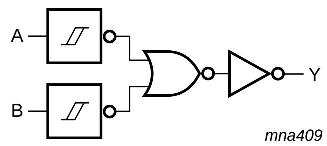


Fig 3. Logic diagram (one Schmitt trigger)

6. Pinning information

6.1 Pinning

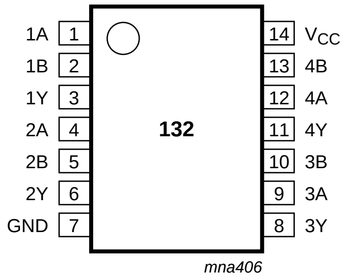


Fig 4. Pin configuration DIP14, SO14 and (T)SSOP14

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_{CC}	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; X = don't care.

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_{CC}	supply voltage			–0.5	+7	V
I_{IK}	input clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	[1]	-	±20	mA
I_{OK}	output clamping current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V	[1]	-	±20	mA
I_O	output current	-0.5 V $< V_O < V_{CC} + 0.5$ 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		[2]			
	DIP14 package			-	750	mW
	SO14, and (T)SSOP14 packages			-	500	mW

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

[2] For DIP14 package: P_{tot} derates linearly with 12 mW/K above 70 °C.
For SO14 package: P_{tot} derates linearly with 8 mW/K above 70 °C.
For (T)SSOP14 packages: P_{tot} derates linearly with 5.5 mW/K above 60 °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_{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V_I	input voltage		0	-	V_{CC}	0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	0	-	V_{CC}	V
T_{amb}	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	
74HC132										
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}								
		$I_O = -20\ \mu A$; $V_{CC} = 2.0\ V$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_O = -20\ \mu A$; $V_{CC} = 4.5\ V$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_O = -20\ \mu A$; $V_{CC} = 6.0\ V$	5.9	6.0	-	5.9	-	5.9	-	V
		$I_O = -4.0\ mA$; $V_{CC} = 4.5\ V$	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 output voltage	$V_I = V_{T+}$ or V_{T-}								
		$I_O = 20\ \mu A$; $V_{CC} = 2.0\ V$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 20\ \mu A$; $V_{CC} = 4.5\ V$	-	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
		$I_O = 4.0\ mA$; $V_{CC} = 4.5\ V$	-	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
I_I	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0\ V$	-	-	±0.1	-	±1.0	-	±1.0	μA
I_{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0\ A$; $V_{CC} = 6.0\ V$	-	-	2.0	-	20	-	40	μA
C_I	input capacitance		-	3.5	-	-	-	-	-	pF
74HCT132										
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}; $V_{CC} = 4.5\ V$								
		$I_O = -20\ \mu A$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_O = -4.0\ mA$	3.98	4.32	-	3.84	-	3.7	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}; $V_{CC} = 4.5\ V$								
		$I_O = 20\ \mu A$;	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 4.0\ mA$;	-	0.15	0.26	-	0.33	-	0.4	V
I_I	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5\ V$	-	-	±0.1	-	±1.0	-	±1.0	μA
I_{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0\ A$; $V_{CC} = 5.5\ V$	-	-	2.0	-	20	-	40	μA
ΔI_{CC}	additional supply current	per input pin; $V_I = V_{CC} - 2.1\ V$; $I_O = 0\ A$; other inputs at V_{CC} or GND; $V_{CC} = 4.5\ V$ to $5.5\ V$	-	30	108	-	135	-	147	μA
C_I	input capacitance		-	3.5	-	-	-	-	-	pF

11. Dynamic characteristics

Table 7. Dynamic characteristics

GND = 0 V; C_L = 50 pF; for load circuit see Figure 6.

Symbol	Parameter	Conditions		25 °C			−40 °C to +125 °C		Unit
				Min	Typ	Max	Max (85 °C)	Max (125 °C)	
74HC132									
t_{pd}	propagation delay	nA, nB to nY; see Figure 5	[1]						
		V_{CC} = 2.0 V		-	36	125	155	190	ns
		V_{CC} = 4.5 V		-	13	25	31	38	ns
		V_{CC} = 5.0 V; C_L = 15 pF		-	11	-	-	-	ns
		V_{CC} = 6.0 V		-	10	21	26	32	ns
t_t	transition time	see Figure 5	[2]						
		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
C_{PD}	power dissipation capacitance	per package; V_I = GND to V_{CC}	[3]	-	24	-	-	-	pF
74HCT132									
t_{pd}	propagation delay	nA, nB to nY; see Figure 5	[1]						
		V_{CC} = 4.5 V		-	20	33	41	50	ns
		V_{CC} = 5.0 V; C_L = 15 pF		-	17	-	-	-	ns
t_t	transition time	V_{CC} = 4.5 V; see Figure 5	[2]	-	7	15	19	22	ns
C_{PD}	power dissipation capacitance	per package; V_I = GND to V_{CC} − 1.5 V	[3]	-	20	-	-	-	pF

[1] t_{pd} is the same as t_{PHL} and t_{PLH}.

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

[3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW):

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

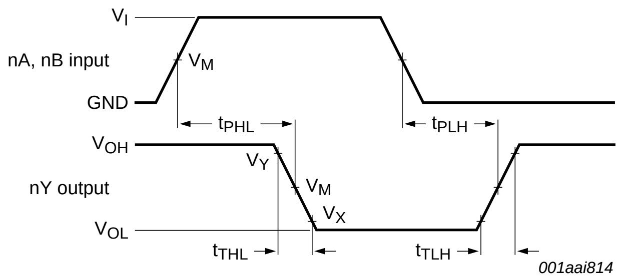
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

$\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

12. Waveforms



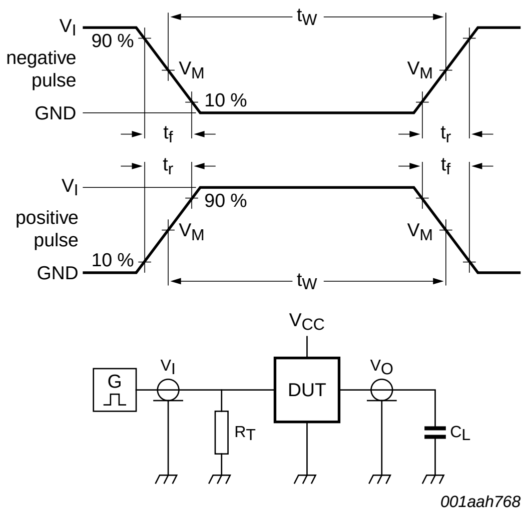
Measurement points are given in Table 8.

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

Fig 5. Input to output propagation delays

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	$0.1V_{CC}$	$0.9V_{CC}$



Test data is given in Table 9.

Definitions 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 6. Load circuitry for measuring switching times

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}

13. Transfer characteristics

Table 10. Transfer characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see Figure 7 and Figure 8.

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

14. Transfer characteristics waveforms

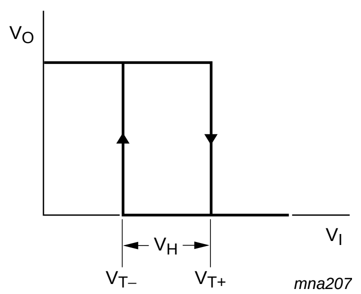


Fig 7. Transfer characteristics

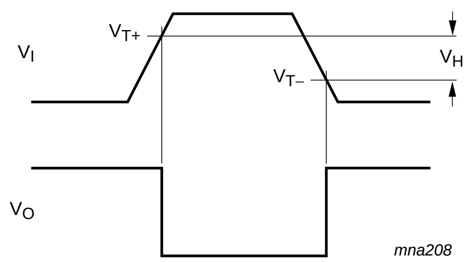
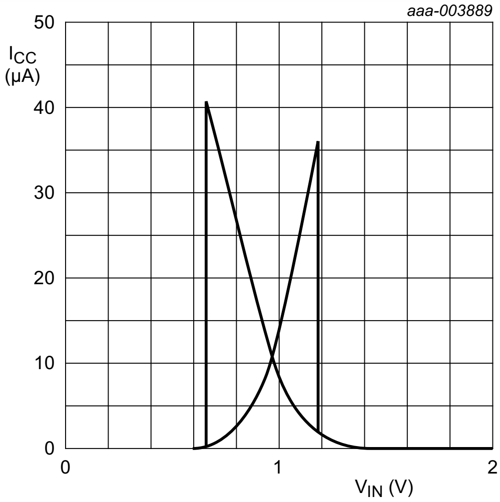
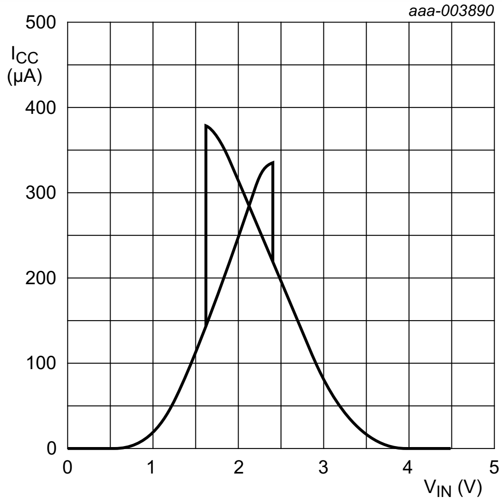


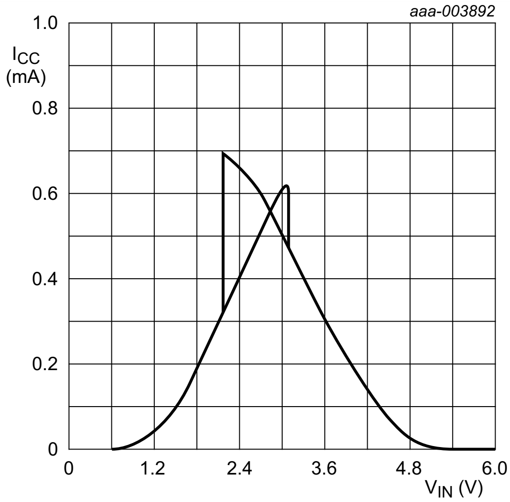
Fig 8. Transfer characteristics definitions



a. V_{CC} = 2.0 V

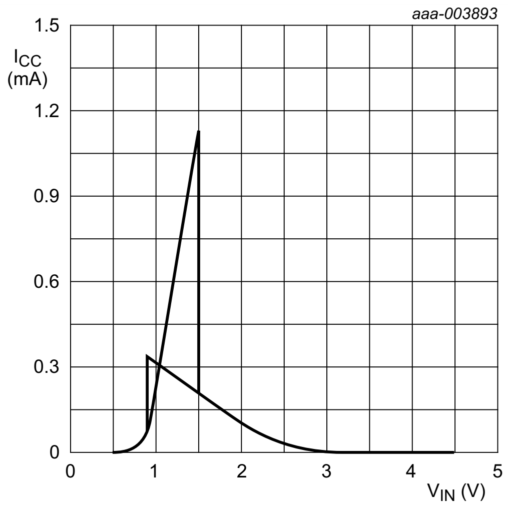


b. V_{CC} = 4.5 V

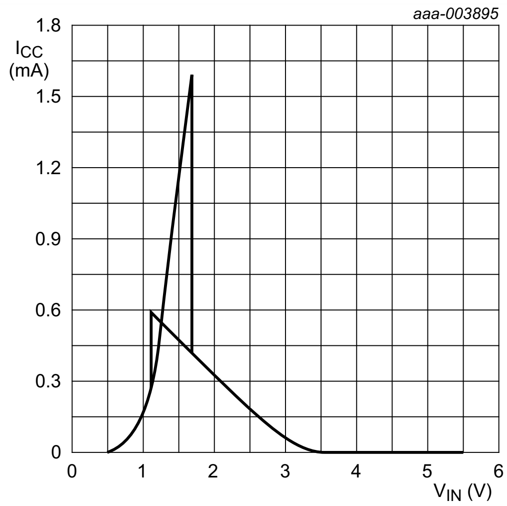


c. V_{CC} = 6.0 V

Fig 9. Typical 74HC132 transfer characteristics



a. V_{CC} = 4.5 V



b. V_{CC} = 5.5 V

Fig 10. Typical 74HCT132 transfer characteristics

15. Application information

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

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

P_{add} = additional power dissipation (μW);

f_i = input frequency (MHz);

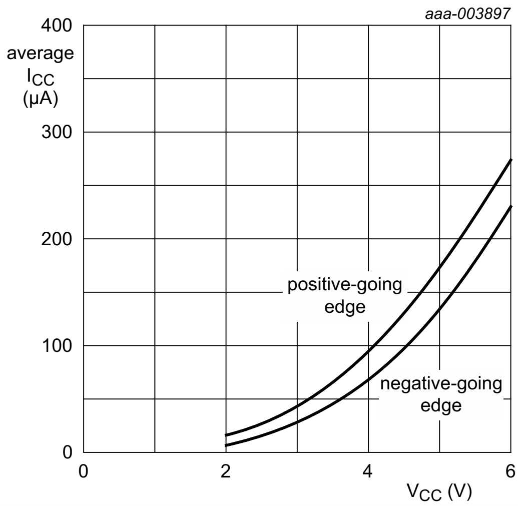
t_r = rise time (ns); 10 % to 90 %;

t_f = fall time (ns); 90 % to 10 %;

$\Delta I_{CC(AV)}$ = average additional supply current (μA).

Average $\Delta I_{CC(AV)}$ differs with positive or negative input transitions, as shown in Figure 11 and Figure 12.

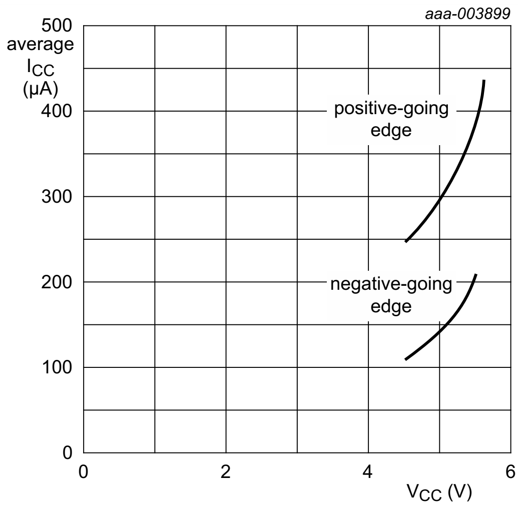
An example of a relaxation circuit using the 74HC132; 74HCT132 is shown in Figure 13.



(1) Positive-going edge.

(2) Negative-going edge.

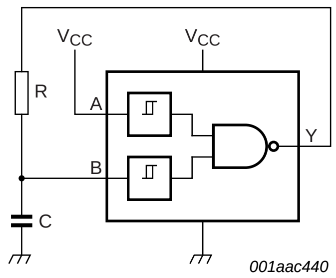
Fig 11. Average additional supply current as a function of V_{CC} for 74HC132; linear change of V_I between $0.1V_{CC}$ to $0.9V_{CC}$.



(1) Positive-going edge.

(2) Negative-going edge.

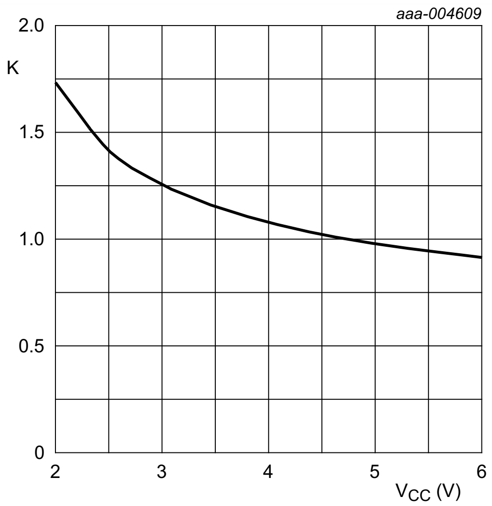
Fig 12. Average additional supply current as a function of V_{CC} for 74HCT132; linear change of V_I between $0.1V_{CC}$ to $0.9V_{CC}$.



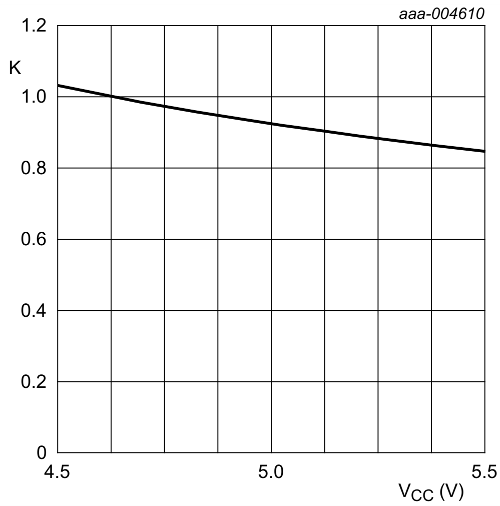
For 74HC132 and 74HCT132: $f = \frac{1}{T} \approx \frac{1}{K \times RC}$

For K-factor, see Figure 14

Fig 13. Relaxation oscillator



K-factor for 74HC132

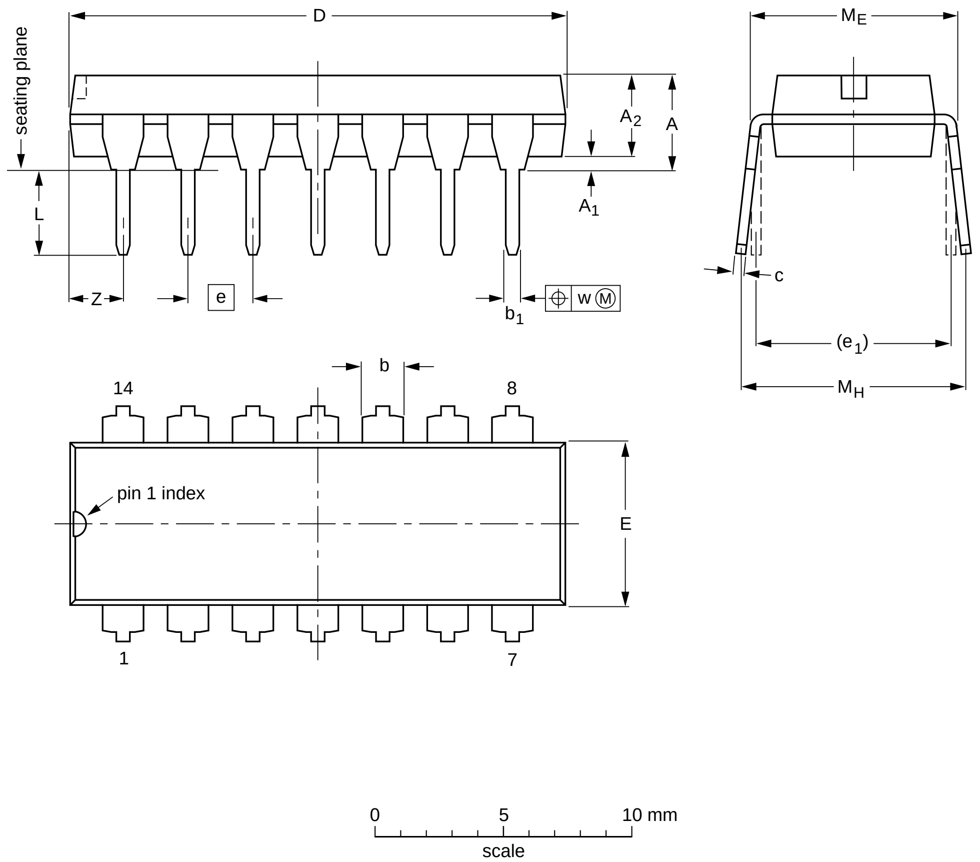


K-factor for 74HCT132

Fig 14. Typical K-factor for relaxation oscillator

16. Package outline

DIP14: plastic dual in-line package; 14 leads (300 mil) **SOT27-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.13	0.53 0.38	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.2
inches	0.17	0.02	0.13	0.068 0.044	0.021 0.015	0.014 0.009	0.77 0.73	0.26 0.24	0.1	0.3	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.087

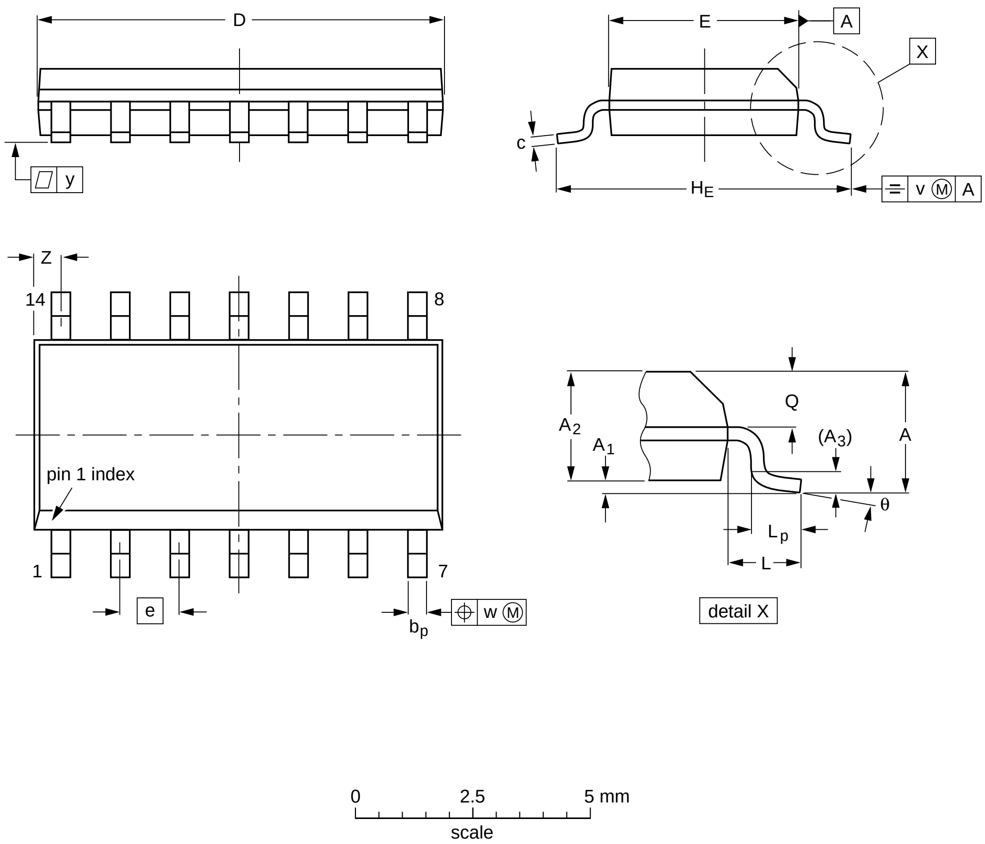
Note

1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT27-1	050G04	MO-001	SC-501-14			~~99-12-27~~ 03-02-13

Fig 15. Package outline SOT27-1 (DIP14)

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_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	8.75 8.55	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	0.35 0.34	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

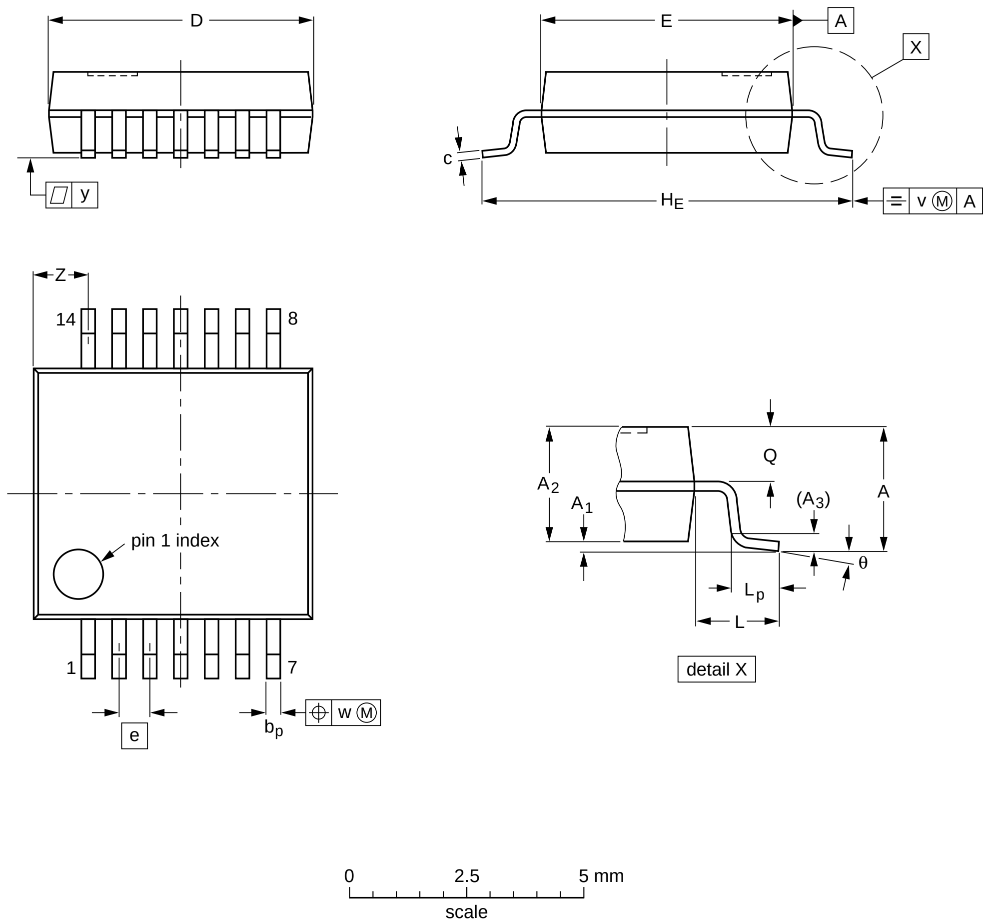
Note

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			
SOT108-1	076E06	MS-012				~~99-12-27~~ 03-02-19

Fig 16. Package outline SOT108-1 (SO14)

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm **SOT337-1**



DIMENSIONS (mm are the original 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	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.4 0.9	8^o 0^o

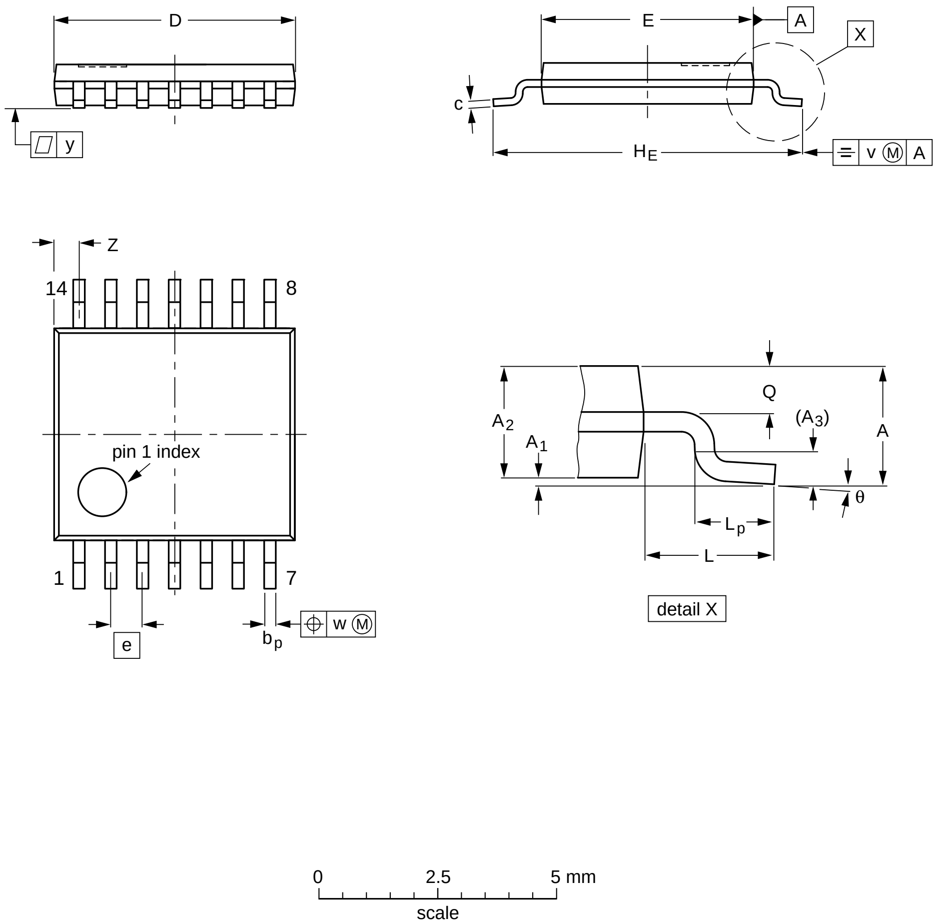
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT337-1		MO-150				~~99-12-27~~ 03-02-19

Fig 17. Package outline SOT337-1 (SSOP14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm **SOT402-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.72 0.38	8^o 0^o

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT402-1		MO-153				~~99-12-27~~ 03-02-18

Fig 18. Package outline SOT402-1 (TSSOP14)

17. Abbreviations

Table 11. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
LSTTL	Low-power Schottky Transistor-Transistor Logic
MM	Machine Model
TTL	Transistor-Transistor Logic

18. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT132 v.3	20120830	Product data sheet	-	74HC_HCT132_CNV v.2
Modifications:	• 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. • Figure 14 added (typical K-factor for relaxation oscillator).			
74HC_HCT132_CNV v.2	19970826	Product specification	-	-

19. Legal information

19.1 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.
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".

[3] 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 URL http://www.nxp.com.

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21. Contents

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