74AHC74; 74AHCT74

Dual D-type flip-flop with set and reset; positive-edge trigger

Rev. 05 — 9 June 2008 Product data sheet

1. General description

The 74AHC74; 74AHCT74 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. 7-A.

The 74AHC74; 74AHCT74 is a dual positive-edge triggered, D-type flip-flop with individual data inputs (D), clock inputs (CP), set inputs ($\overline{SD}$) and reset inputs ($\overline{RD}$). It also has complementary outputs (Q and $\overline{Q}$).

The set and reset are asynchronous active LOW inputs that operate independent of the clock input. Information on the data input is transferred to the Q output on the LOW to HIGH transition of the clock pulse. The data inputs must be stable one set-up time prior to the LOW to HIGH clock transition for predictable operation.

Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times.

2. Features

- Balanced propagation delays
- All inputs have Schmitt-trigger actions
- Inputs accept voltages higher than V_{CC}
- Input levels:
  - For 74AHC74: CMOS level
  - For 74AHCT74: TTL level
- ESD protection:
  - HBM EIA/JESD22-A114E exceeds 2000 V
  - MM EIA/JESD22-A115-A exceeds 200 V
  - CDM EIA/JESD22-C101C exceeds 1000 V
- Multiple package options
- Specified from –40 °C to +85 °C and from –40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AHC74				
74AHC74D	–40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74AHC74PW	–40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74AHC74BQ	–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
74AHCT74				
74AHCT74D	–40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74AHCT74PW	–40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74AHCT74BQ	–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

4. Functional diagram

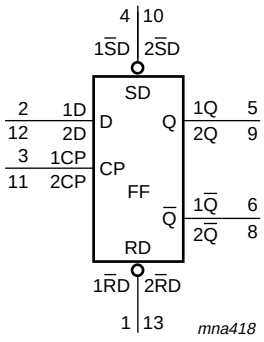


Fig 1. Functional diagram

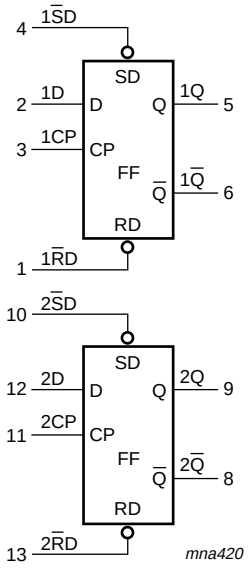


Fig 2. Logic symbol

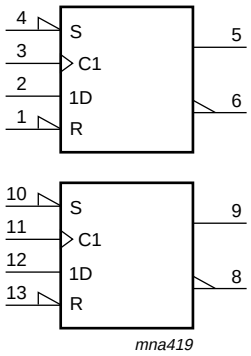


Fig 3. IEC logic symbol

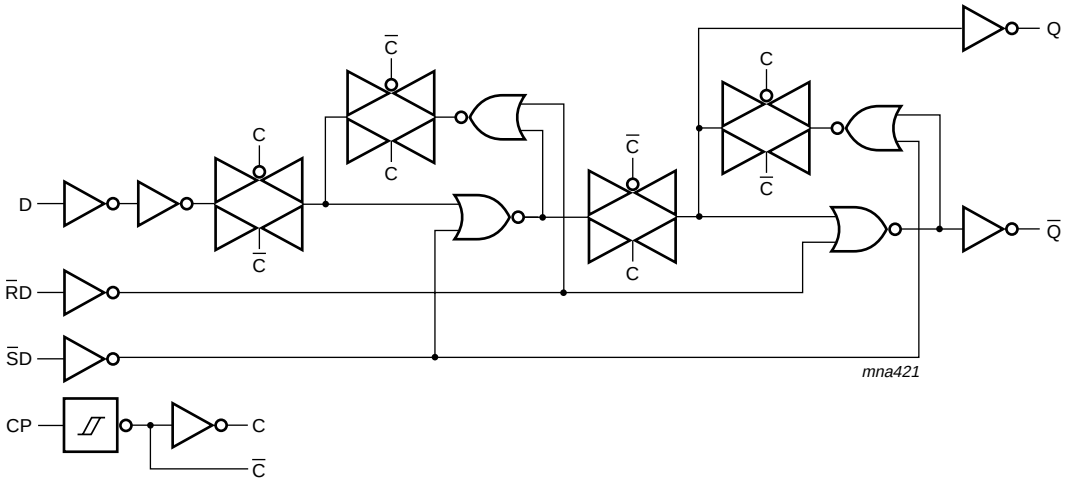


Fig 4. Logic diagram (one flip-flop)

5. Pinning information

5.1 Pinning

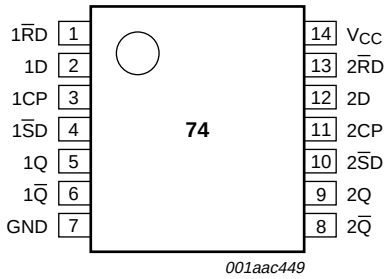
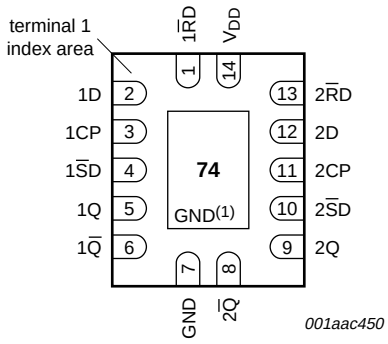


Fig 5. Pin configuration SO14 and TSSOP14



Transparent top view

(1) The die substrate is attached to this pad using conductive die attach material. It can not be used as supply pin or input.

Fig 6. Pin configuration DHVQFN14

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1$\overline{RD}$	1	asynchronous reset direct input (active LOW)
1D	2	data input
1CP	3	clock input (LOW to HIGH, edge-triggered)
1$\overline{SD}$	4	asynchronous set direct input (active LOW)
1Q	5	true flip-flop output
1$\overline{Q}$	6	complement flip-flop output
GND	7	ground (0 V)
2$\overline{Q}$	8	complement flip-flop output
2Q	9	true flip-flop output
2$\overline{SD}$	10	asynchronous set direct input (active LOW)
2CP	11	clock input (LOW to HIGH, edge-triggered)
2D	12	data input
2$\overline{RD}$	13	asynchronous reset direct input (active LOW)
V_{CC}	14	supply voltage

6. Functional description

Table 3. Function table[1]

Control			Input	Output			
$n\overline{SD}$	$n\overline{RD}$	nCP	nD	nQ	$n\overline{Q}$	nQ_{n+1}	$n\overline{Q}_{n+1}$
L	H	X	X	H	L	L	H
H	L	X	X	L	H	H	L
L	L	X	X	H	H	-	-
H	H	↑	L	-	-	L	H
H	H	↑	H	-	-	H	L

[1] H = HIGH voltage level;
L = LOW voltage level;
↑ = LOW to HIGH transition;
Q_{n+1} = state after the next LOW to HIGH CP transition;
X = don't care.

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
V_I	input voltage			–0.5	+7.0	V
I_{IK}	input clamping current	$V_I < –0.5$ V	[1]	–20	-	mA
I_{OK}	output clamping current	$V_O < –0.5$ V or $V_O > V_{CC} + 0.5$ V	[1]	–20	+20	mA
I_O	output current	$V_O = –0.5$V to ($V_{CC} + 0.5$ V)		–25	+25	mA
I_{CC}	supply current			-	+75	mA
I_{GND}	ground current			–75	-	mA
T_{stg}	storage temperature			–65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = –40$ °C to +125 °C	[2]	-	500	mW

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

[2] For SO14 packages: above 70 °C the value of P_{tot} derates linearly at 8 mW/K.
For TSSOP14 packages: above 60 °C the value of P_{tot} derates linearly at 5.5 mW/K.
For DHVQFN14 packages: above 60 °C the value of P_{tot} derates linearly at 4.5 mW/K.

8. Recommended operating conditions

Table 5. Operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
74AHC74						
V_{CC}	supply voltage		2.0	5.0	5.5	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		–40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CC} = 3.0 V to 3.6 V	-	-	100	ns/V
		V_{CC} = 4.5 V to 5.5 V	-	-	20	ns/V
74AHCT74						
V_{CC}	supply voltage		4.5	5.0	5.5	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		–40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CC} = 4.5 V to 5.5 V	-	-	20	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	Typ	Max	Min	Max	Min	Max	
74AHC74										
V_{IH}	HIGH-level input voltage	V_{CC} = 2.0 V	1.5	-	-	1.5	-	1.5	-	V
		V_{CC} = 3.0 V	2.1	-	-	2.1	-	2.1	-	V
		V_{CC} = 5.5 V	3.85	-	-	3.85	-	3.85	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 2.0 V	-	-	0.5	-	0.5	-	0.5	V
		V_{CC} = 3.0 V	-	-	0.9	-	0.9	-	0.9	V
		V_{CC} = 5.5 V	-	-	1.65	-	1.65	-	1.65	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}								
		I_O = –50 µA; V_{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I_O = –50 µA; V_{CC} = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I_O = –50 µA; V_{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I_O = –4.0 mA; V_{CC} = 3.0 V	2.58	-	-	2.48	-	2.40	-	V
		I_O = –8.0 mA; V_{CC} = 4.5 V	3.94	-	-	3.80	-	3.70	-	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}								
		I_O = 50 µA; V_{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 50 µA; V_{CC} = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 50 µA; V_{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 4.0 mA; V_{CC} = 3.0 V	-	-	0.36	-	0.44	-	0.55	V
		I_O = 8.0 mA; V_{CC} = 4.5 V	-	-	0.36	-	0.44	-	0.55	V

Table 6. Static characteristics *…continued*

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	
I_I	input leakage current	V_I = 5.5 V or GND; V_{CC} = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	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
C_I	input capacitance	$V_I = V_{CC}$ or GND	-	3	10	-	10	-	10	pF
74AHCT74										
V_{IH}	HIGH-level input voltage	V_{CC} = 4.5 V to 5.5 V	2.0	-	-	2.0	-	2.0	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 4.5 V to 5.5 V	-	-	0.8	-	0.8	-	0.8	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}; V_{CC} = 4.5 V								
		I_O = –50 µA	4.4	4.5	-	4.4	-	4.4	-	V
		I_O = –8.0 mA	3.94	-	-	3.80	-	3.70	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}; V_{CC} = 4.5 V								
		I_O = 50 µA	-	0	0.1	-	0.1	-	0.1	V
		I_O = 8.0 mA	-	-	0.36	-	0.44	-	0.55	V
I_I	input leakage current	V_I = 5.5 V or GND; V_{CC} = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	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; other pins at V_{CC} or GND; I_O = 0 A; V_{CC} = 4.5 V to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
C_I	input capacitance	$V_I = V_{CC}$ or GND	-	3	10	-	10	-	10	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 9.

Symbol	Parameter	Conditions	25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
74AHC74										
t_{pd}	propagation delay	nCP to nQ, nQ̄; see Figure 7 [2]								
		V_{CC} = 3.0 V to 3.6 V								
		C_L = 15 pF	-	5.2	11.9	1.0	14.0	1.0	15.0	ns
		C_L = 50 pF	-	7.4	15.4	1.0	17.5	1.0	19.5	ns
		V_{CC} = 4.5 V to 5.5 V								
		C_L = 15 pF	-	3.7	7.3	1.0	8.5	1.0	9.5	ns
		C_L = 50 pF	-	5.2	9.3	1.0	10.5	1.0	12.0	ns
		nSD̄, nRD̄ to nQ, nQ̄; see Figure 8								
		V_{CC} = 3.0 V to 3.6 V								
		C_L = 15 pF	-	5.4	12.3	1.0	14.5	1.0	15.5	ns
		C_L = 50 pF	-	7.7	15.8	1.0	18.0	1.0	20.0	ns
		V_{CC} = 4.5 V to 5.5 V								
		C_L = 15 pF	-	3.7	7.7	1.0	9.0	1.0	10.0	ns
		C_L = 50 pF	-	5.3	9.7	1.0	11.0	1.0	12.5	ns
f_{max}	maximum frequency	see Figure 7								
		V_{CC} = 3.0 V to 3.6 V								
		C_L = 15 pF	80	125	-	45	-	45	-	MHz
		C_L = 50 pF	50	75	-	70	-	70	-	MHz
		V_{CC} = 4.5 V to 5.5 V								
		C_L = 15 pF	130	170	-	110	-	110	-	MHz
		C_L = 50 pF	90	115	-	75	-	75	-	MHz
t_W	pulse width	CP HIGH or LOW; nSD̄, nRD̄ LOW; see Figure 7 and 8								
		V_{CC} = 3.0 V to 3.6 V	6.0	-	-	7.0	-	7.0	-	ns
		V_{CC} = 4.5 V to 5.5 V	5.0	-	-	5.0	-	5.0	-	ns
t_{su}	set-up time	nD to nCP; see Figure 7								
		V_{CC} = 3.0 V to 3.6 V	6.0	-	-	7.0	-	7.0	-	ns
		V_{CC} = 4.5 V to 5.5 V	5.0	-	-	5.0	-	5.0	-	ns
t_h	hold time	nD to nCP; see Figure 7								
		V_{CC} = 3.0 V to 3.6 V	0.5	-	-	0.5	-	0.5	-	ns
		V_{CC} = 4.5 V to 5.5 V	0.5	-	-	0.5	-	0.5	-	ns
t_{rec}	recovery time	nRD̄ to nCP; see Figure 8								
		V_{CC} = 3.0 V to 3.6 V	5.0	-	-	5.0	-	5.0	-	ns
		V_{CC} = 4.5 V to 5.5 V	3.0	-	-	3.0	-	3.0	-	ns

Table 7. Dynamic characteristics *…continued*

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 9.

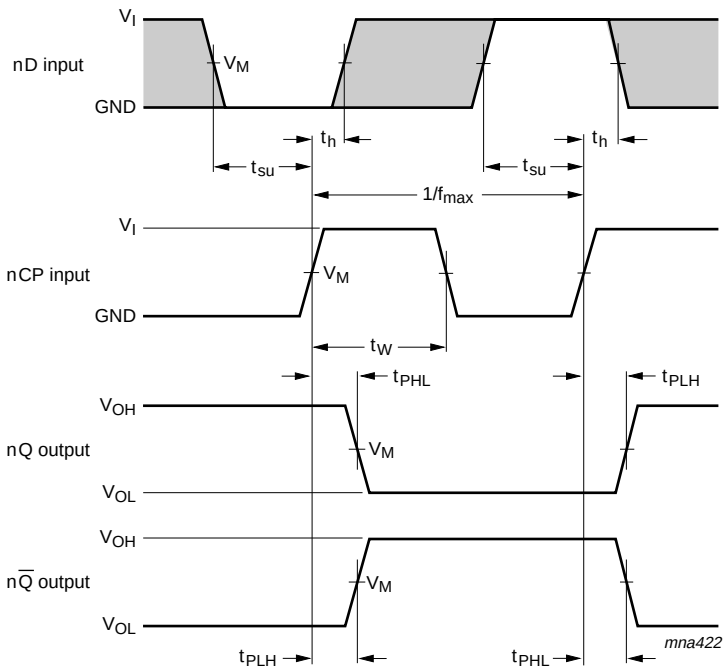
Symbol	Parameter	Conditions		25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit
				Min	Typ[1]	Max	Min	Max	Min	Max	
C_{PD}	power dissipation capacitance	f_i = 1 MHz; V_I = GND to V_{CC}	[3]	-	12	-	-	-	-	-	pF
74AHCT74; V_{CC} = 4.5 V to 5.5 V											
t_{pd}	propagation delay	nCP to nQ, nQ̄; see Figure 7	[2]								
		C_L = 15 pF		-	3.3	7.8	1.0	9.0	1.0	10.0	ns
		C_L = 50 pF		-	4.8	8.8	1.0	10.0	1.0	11.0	ns
		nSD̄, nRD̄ to nQ, nQ̄; see Figure 7									
		C_L = 15 pF		-	3.7	10.4	1.0	12.0	1.0	13.0	ns
		C_L = 50 pF		-	5.3	11.4	1.0	13.0	1.0	14.5	ns
f_{max}	maximum frequency	see Figure 7									
		C_L = 15 pF		100	160	-	80	-	80	-	MHz
		C_L = 50 pF		80	140	-	65	-	65	-	MHz
t_W	pulse width	CP HIGH or LOW; nSD̄, nRD̄ LOW; see Figure 7 and 8		5.0	-	-	5.0	-	5.0	-	ns
t_{su}	set-up time	nD to nCP; see Figure 7		5.0	-	-	5.0	-	5.0	-	ns
t_h	hold time	nD to nCP; see Figure 7		0	-	-	0	-	0	-	ns
t_{rec}	recovery time	nRD̄ to nCP; see Figure 8		3.5	-	-	3.5	-	3.5	-	ns
C_{PD}	power dissipation capacitance	f_i = 1 MHz; V_I = GND to V_{CC}	[3]	-	16	-	-	-	-	-	pF

[1] Typical values are measured at nominal supply voltage (V_{CC} = 3.3 V and V_{CC} = 5.0 V).

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

[3] C_{PD} is used to determine the dynamic power dissipation (P_D in µW).
$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ 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;
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

11. Waveforms

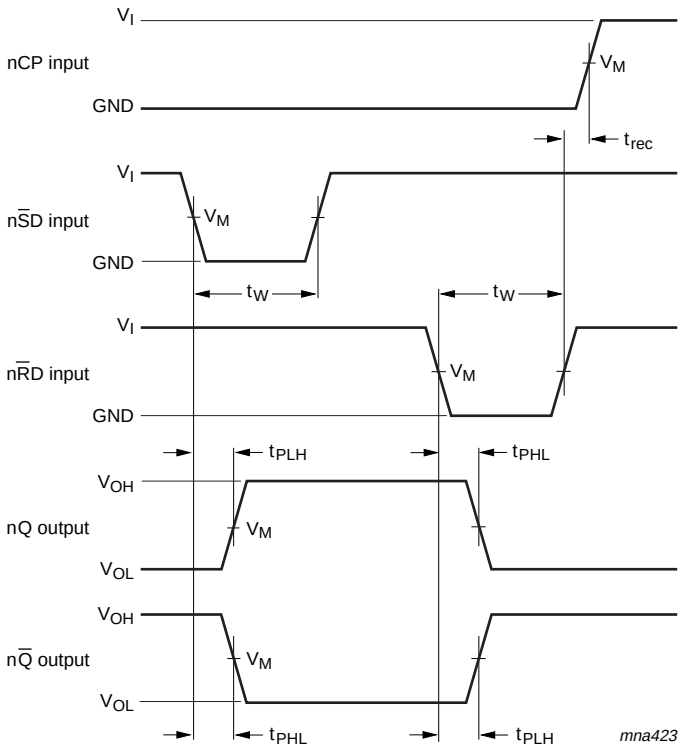


Measurement points are given in Table 8.

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

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

Fig 7. Clock pulse width, maximum frequency, set-up times, hold times and input to output propagation delays



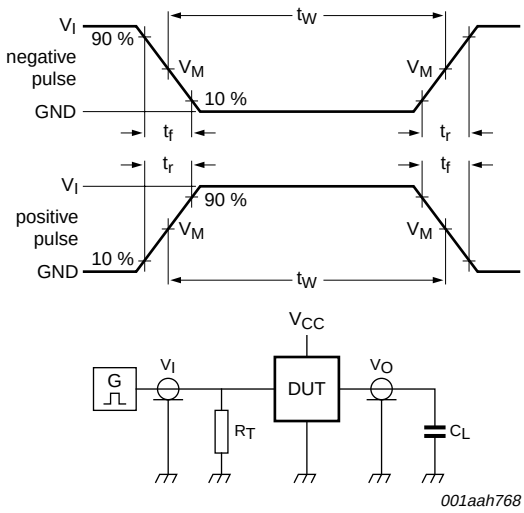
Measurement points are given in Table 8.

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

Fig 8. Set and reset pulse widths, recovery time and input to output propagation delays

Table 8. Measurement points

Type	Input	Output
	V_M	V_M
74AHC74	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
74AHCT74	1.5 V	$0.5 \times V_{CC}$



For test data see Table 9.

Definitions for test circuit:

C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

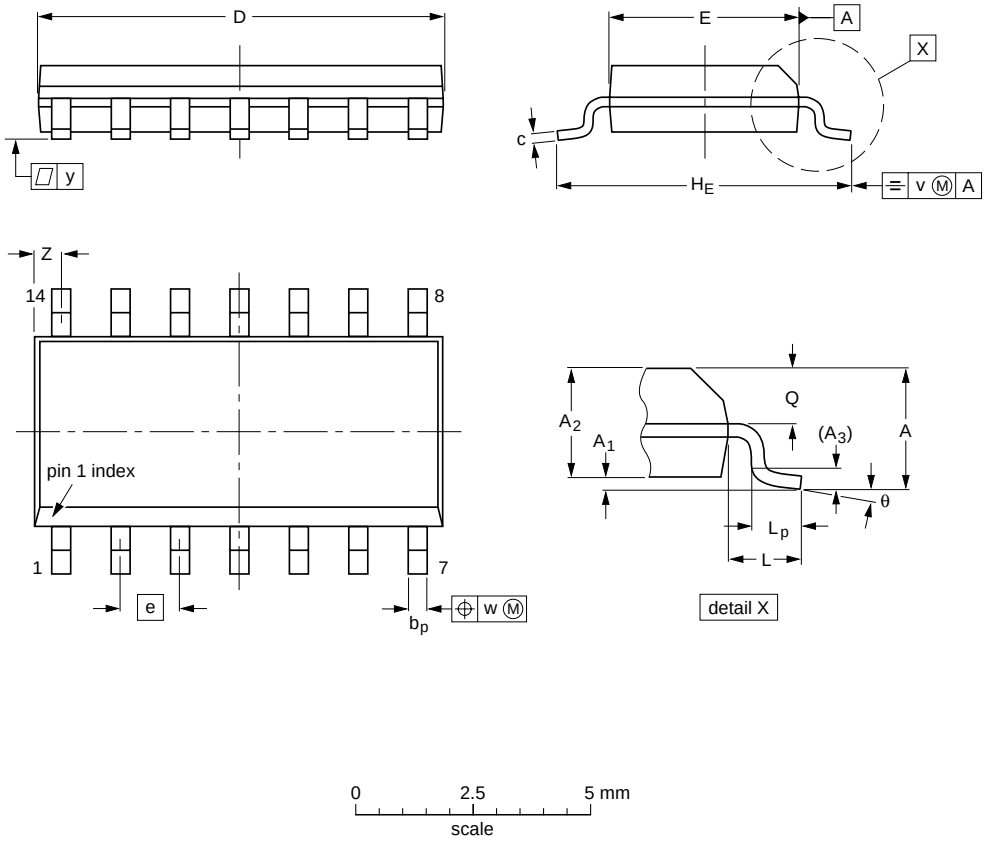
Fig 9. Load circuitry for switching times

Table 9. Test data

Type	Input		Load	Test
	V_I	t_r, t_f	C_L	
74AHC74	V_{CC}	≤ 3.0 ns	50 pF, 15 pF	t_{PLH}, t_{PHL}
74AHCT74	3.0 V	≤ 3.0 ns	50 pF, 15 pF	t_{PLH}, t_{PHL}

12. Package outline

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^o 0^o
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	

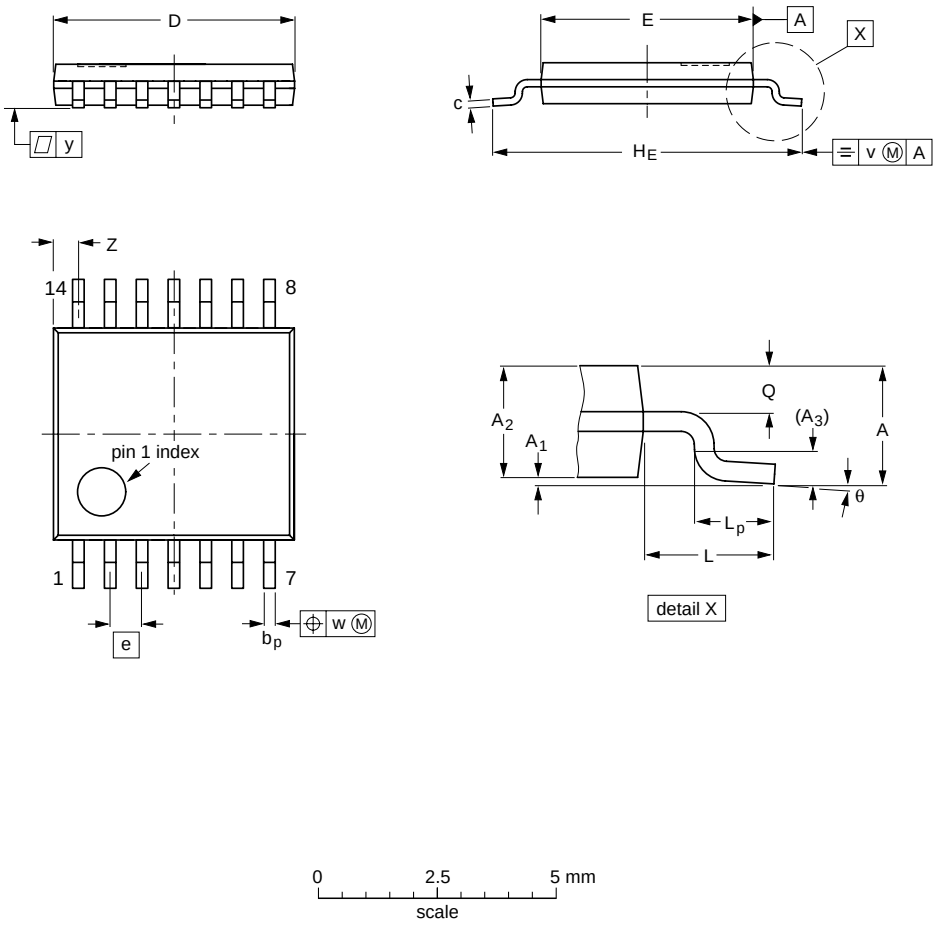
Note

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 10. Package outline SOT108-1 (SO14)

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

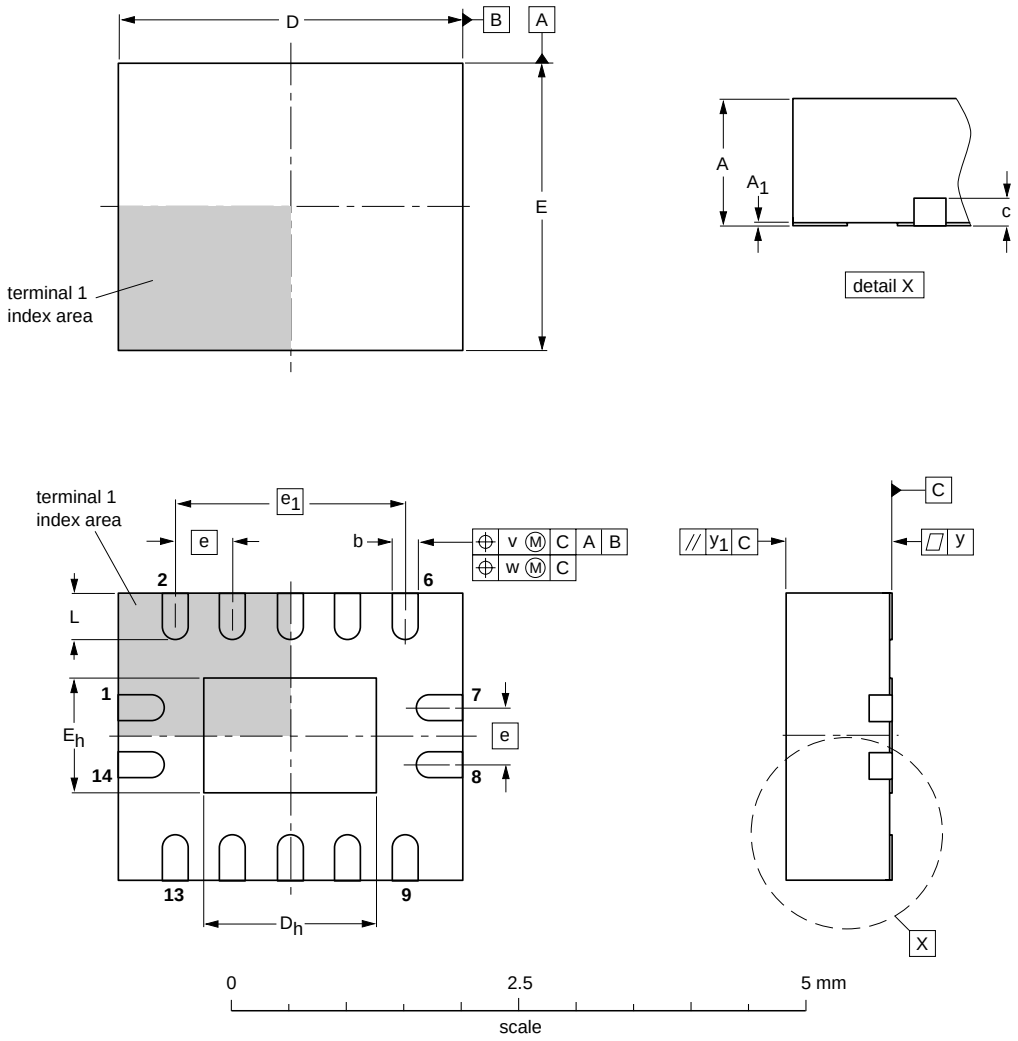
Notes

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 11. 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**



DIMENSIONS (mm are the original dimensions)

UNIT	$A^{(1)}$ max.	A_1	b	c	$D^{(1)}$	D_h	$E^{(1)}$	E_h	e	e_1	L	v	w	y	y_1
mm	1	0.05 0.00	0.30 0.18	0.2	3.1 2.9	1.65 1.35	2.6 2.4	1.15 0.85	0.5	2	0.5 0.3	0.1	0.05	0.05	0.1

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT762-1	- - -	MO-241	- - -			~~02-10-17~~ 03-01-27

Fig 12. Package outline SOT762-1 (DHVQFN14)

13. Abbreviations

Table 10. Abbreviations

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

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT74_5	20080609	Product data sheet	-	74AHC_AHCT74_4
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. • Table 6: the conditions for input leakage current have been changed.			
74AHC_AHCT74_4	20050207	Product data sheet	-	74AHC_AHCT74_3
74AHC_AHCT74_3	20040429	Product specification	-	74AHC_AHCT74_2
74AHC_AHCT74_2	19990923	Product specification	-	74AHC_AHCT74_1
74AHC_AHCT74_1	19990805	Product specification	-	-

15. Legal information

15.1 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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17. Contents

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