74LVC74A

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

Rev. 9 — 20 August 2021 Product data sheet

1. General description

The 74LVC74A is a dual edge triggered D-type flip-flop with individual data (nD) inputs, clock (nCP) inputs, set ($n\overline{SD}$) and ($n\overline{RD}$) inputs, and complementary nQ and $n\overline{Q}$ outputs.

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

Schmitt trigger action at all inputs makes the circuit highly tolerant of slower input rise and fall times.

2. Features and benefits

- 5 V tolerant inputs for interlacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- Direct interface with TTL levels
- Complies with JEDEC standard:
  - JESD8-7A (1.65 V to 1.95 V)
  - JESD8-5A (2.3 V to 2.7 V)
  - JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-B exceeds 200 V
  - CDM JESD22-C101E exceeds 1000 V
- Multiple package options
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVC74AD	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74LVC74APW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74LVC74ABQ	-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

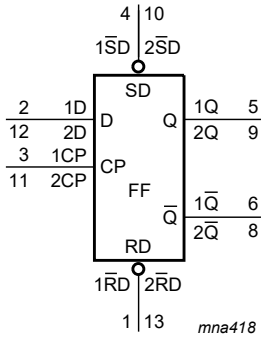


Fig. 1. Logic symbol

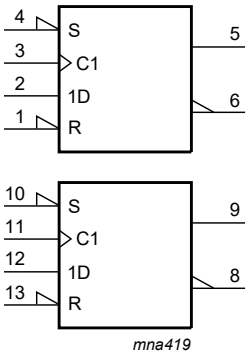


Fig. 2. IEC logic symbol

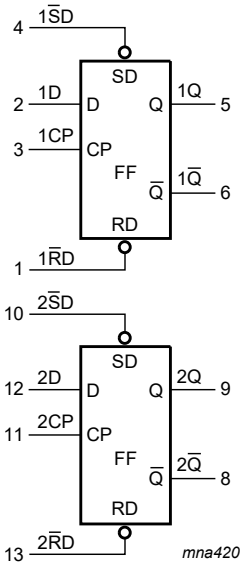


Fig. 3. Functional diagram

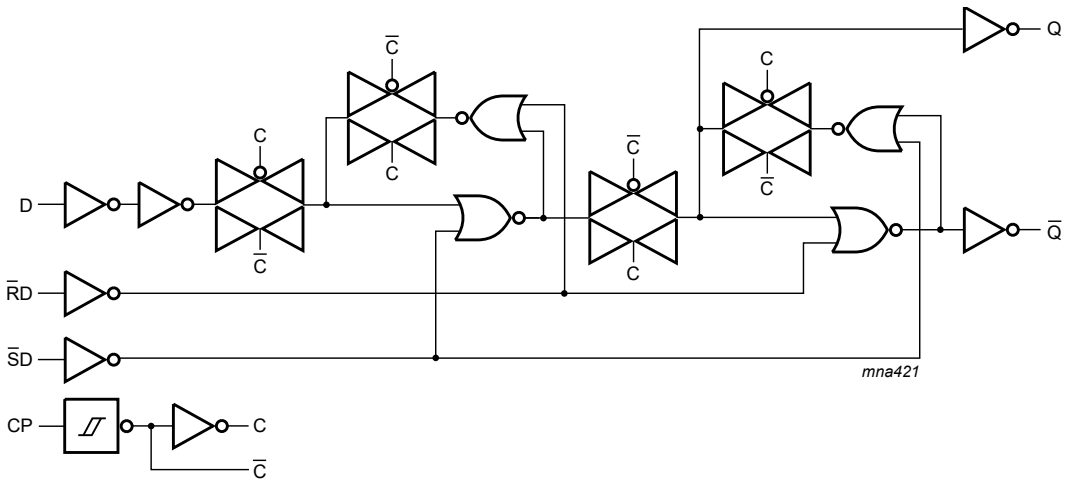


Fig. 4. Logic diagram for one flip-flop

5. Pinning information

5.1. Pinning

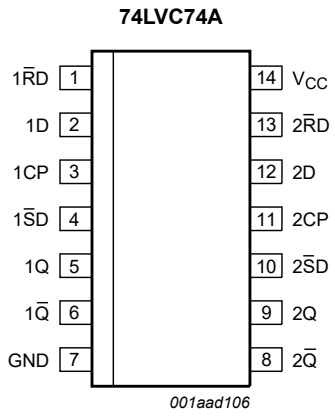
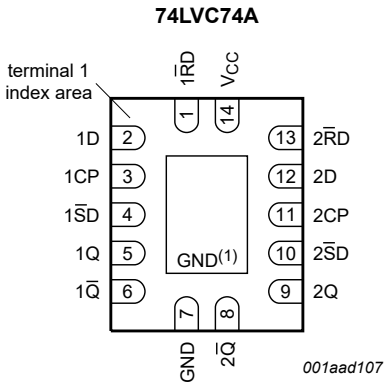


Fig. 5. Pin configuration SOT108-1 (SO14) and SOT402-1 (TSSOP14)



Transparent top view

(1) This is not a ground pin. There is no electrical or mechanical requirement to solder the pad. In case soldered, the solder land should remain floating or connected to GND.

Fig. 6. Pin configuration for SOT762-1 (DHVQFN14)

5.2. Pin description

Table 2. Pin description

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

6. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; X = don't care

Input				Output	
$n\overline{SD}$	$n\overline{RD}$	nCP	nD	nQ	$n\overline{Q}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H	H

Table 4. Function table

H = HIGH voltage level; L = LOW voltage level;

↑ = LOW-to-HIGH transition; Q_{n+1} = state after the next LOW-to-HIGH CP transition

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

7. Limiting values

Table 5. 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	+6.5	V
I_{IK}	input clamping current	$V_I < 0$ V	-50	-	mA
V_I	input voltage	[1]	-0.5	+6.5	V
I_{OK}	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V	-	±50	mA
V_O	output voltage	[2]	-0.5	V_{CC} + 0.5	V
I_O	output current	V_O = 0 V to V_{CC}	-	±50	mA
I_{CC}	supply current		-	100	mA
I_{GND}	ground current		-100	-	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	T_{amb} = -40 °C to +125 °C [3]	-	500	mW

[1] The minimum input voltage ratings may be exceeded if the input current ratings are observed.
[2] The output voltage ratings may be exceeded if the output current ratings are observed.
[3] 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.
For SOT762-1 (DHVQFN14) package: P_{tot} derates linearly with 9.6 mW/K above 98 °C.

8. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage	for maximum speed performance	1.65	-	3.6	V
		for low-voltage applications	1.2	-	3.6	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CC} = 1.65 V to 2.7 V	0	-	20	ns/V
		V_{CC} = 2.7 V to 3.6 V	0	-	10	ns/V

9. Static characteristics

Table 7. Static characteristics

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
V_{IH}	HIGH-level input voltage	V_{CC} = 1.2 V	1.08	-	-	1.08	-	V
		V_{CC} = 1.65 V to 1.95 V	$0.65V_{CC}$	-	-	$0.65V_{CC}$	-	V
		V_{CC} = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V
		V_{CC} = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 1.2 V	-	-	0.12	-	0.12	V
		V_{CC} = 1.65 V to 1.95 V	-	-	$0.35V_{CC}$	-	$0.35V_{CC}$	V
		V_{CC} = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V
		V_{CC} = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}						
		I_O = -100 µA; V_{CC} = 1.65 V to 3.6 V	V_{CC} - 0.2	-	-	V_{CC} - 0.3	-	V
		I_O = -4 mA; V_{CC} = 1.65 V	1.2	-	-	1.05	-	V
		I_O = -8 mA; V_{CC} = 2.3 V	1.8	-	-	1.65	-	V
		I_O = -12 mA; V_{CC} = 2.7 V	2.2	-	-	2.05	-	V
		I_O = -18 mA; V_{CC} = 3.0 V	2.4	-	-	2.25	-	V
		I_O = -24 mA; V_{CC} = 3.0 V	2.2	-	-	2.0	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}						
		I_O = 100 µA; V_{CC} = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V
		I_O = 4 mA; V_{CC} = 1.65 V	-	-	0.45	-	0.65	V
		I_O = 8 mA; V_{CC} = 2.3 V	-	-	0.6	-	0.8	V
		I_O = 12 mA; V_{CC} = 2.7 V	-	-	0.4	-	0.6	V
		I_O = 24 mA; V_{CC} = 3.0 V	-	-	0.55	-	0.8	V
I_I	input leakage current	V_{CC} = 3.6 V; V_I = 5.5 V or GND	-	±0.1	±5	-	±20	µA
I_{CC}	supply current	V_{CC} = 3.6 V; $V_I = V_{CC}$ or GND; I_O = 0 A	-	0.1	10	-	40	µA

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
ΔI_{CC}	additional supply current	per input pin; V_{CC} = 2.7 V to 3.6 V; $V_I = V_{CC}$ - 0.6 V; I_O = 0 A	-	5	500	-	5000	µA
C_I	input capacitance	V_{CC} = 0 V to 3.6 V; V_I = GND to V_{CC}	-	4.0	-	-	-	pF

[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 25 °C.

10. Dynamic characteristics

Table 8. Dynamic characteristics

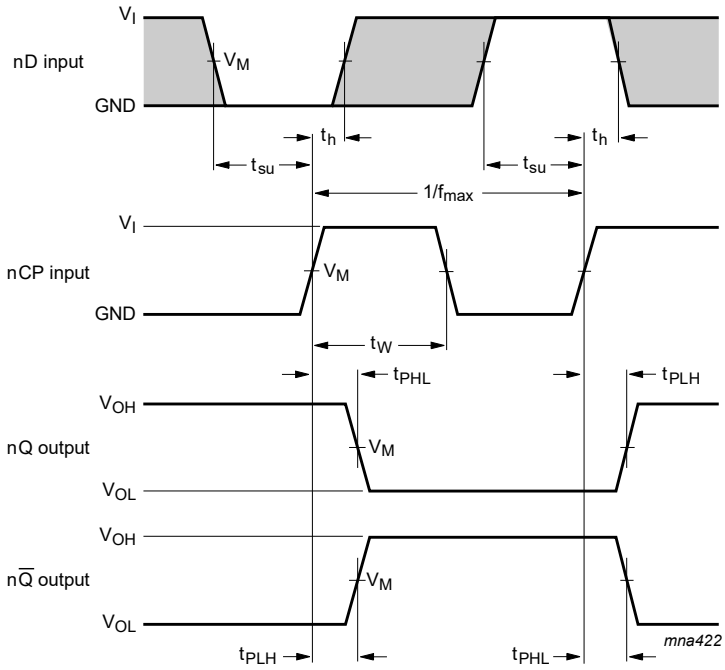
Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 9.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
t_{pd}	propagation delay	nCP to nQ, n$\overline{Q}$; see Fig. 7 [2]						
		V_{CC} = 1.2 V	-	15	-	-	-	ns
		V_{CC} = 1.65 V to 1.95 V	1.0	5.0	10.3	1.0	11.9	ns
		V_{CC} = 2.3 V to 2.7 V	1.8	2.9	5.8	1.8	6.7	ns
		V_{CC} = 2.7 V	1.0	2.7	6.0	1.0	7.5	ns
		V_{CC} = 3.0 V to 3.6 V	1.0	2.6	5.2	1.0	6.5	ns
		n$\overline{SD}$ to nQ, n$\overline{Q}$; see Fig. 8						
		V_{CC} = 1.2 V	-	15	-	-	-	ns
		V_{CC} = 1.65 V to 1.95 V	0.5	4.0	10.6	0.5	12.2	ns
		V_{CC} = 2.3 V to 2.7 V	1.0	2.4	6.1	1.0	7.1	ns
		V_{CC} = 2.7 V	1.0	2.9	6.4	1.0	8.0	ns
		V_{CC} = 3.0 V to 3.6 V	1.0	2.2	5.4	1.0	7.0	ns
		n$\overline{RD}$ to nQ, n$\overline{Q}$; see Fig. 8						
		V_{CC} = 1.2 V	-	15	-	-	-	ns
		V_{CC} = 1.65 V to 1.95 V	0.5	4.1	10.7	0.5	12.4	ns
		V_{CC} = 2.3 V to 2.7 V	1.0	2.4	6.1	1.0	7.1	ns
		V_{CC} = 2.7 V	1.0	3.0	6.4	1.0	8.0	ns
		V_{CC} = 3.0 V to 3.6 V	1.0	2.2	5.4	1.0	7.0	ns
t_W	pulse width	clock HIGH or LOW; see Fig. 7						
		V_{CC} = 1.65 V to 1.95 V	5.0	-	-	5.0	-	ns
		V_{CC} = 2.3 V to 2.7 V	4.0	-	-	4.0	-	ns
		V_{CC} = 2.7 V	3.3	-	-	4.5	-	ns
		V_{CC} = 3.0 V to 3.6 V	3.3	1.3	-	4.5	-	ns
		set or reset LOW; see Fig. 8						
		V_{CC} = 1.65 V to 1.95 V	5.0	-	-	5.0	-	ns
		V_{CC} = 2.3 V to 2.7 V	4.0	-	-	4.0	-	ns
		V_{CC} = 2.7 V	3.3	-	-	4.5	-	ns
		V_{CC} = 3.0 V to 3.6 V	3.3	1.7	-	4.5	-	ns

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
t_{rec}	recovery time	set or reset; see Fig. 8						
		V_{CC} = 1.65 V to 1.95 V	1.5	-	-	1.5	-	ns
		V_{CC} = 2.3 V to 2.7 V	1.5	-	-	1.5	-	ns
		V_{CC} = 2.7 V	1.5	-	-	1.0	-	ns
		V_{CC} = 3.0 V to 3.6 V	+1.0	-3.0	-	1.0	-	ns
t_{su}	set-up time	nD to nCP; see Fig. 7						
		V_{CC} = 1.65 V to 1.95 V	3.0	-	-	3.0	-	ns
		V_{CC} = 2.3 V to 2.7 V	2.5	-	-	2.5	-	ns
		V_{CC} = 2.7 V	2.2	-	-	2.2	-	ns
		V_{CC} = 3.0 V to 3.6 V	2.0	0.8	-	2.0	-	ns
t_h	hold time	nD to nCP; see Fig. 7						
		V_{CC} = 1.65 V to 1.95 V	2.0	-	-	2.0	-	ns
		V_{CC} = 2.3 V to 2.7 V	1.5	-	-	1.5	-	ns
		V_{CC} = 2.7 V	1.0	-	-	1.0	-	ns
		V_{CC} = 3.0 V to 3.6 V	+1.0	-0.2	-	1.0	-	ns
f_{max}	maximum frequency	nCP; see Fig. 7						
		V_{CC} = 1.65 V to 1.95 V	100	-	-	80	-	MHz
		V_{CC} = 2.3 V to 2.7 V	125	-	-	100	-	MHz
		V_{CC} = 2.7 V	150	-	-	120	-	MHz
		V_{CC} = 3.0 V to 3.6 V	150	250	-	120	-	MHz
$t_{sk(o)}$	output skew time	V_{CC} = 3.0 V to 3.6 V [3]	-	-	1.0	-	1.5	ns
C_{PD}	power dissipation capacitance	per flip-flop; V_I = GND to V_{CC} [4]						
		V_{CC} = 1.65 V to 1.95 V	-	12.4	-	-	-	pF
		V_{CC} = 2.3 V to 2.7 V	-	16.0	-	-	-	pF
		V_{CC} = 3.0 V to 3.6 V	-	19.1	-	-	-	pF

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.2 V, 1.8 V, 2.5 V, 2.7 V and 3.3 V respectively.
[2] t_{pd} is the same as t_{PLH} and t_{PHL}.
[3] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.
[4] 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 Volts
N = number of inputs switching
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs

10.1. Waveforms and test circuit

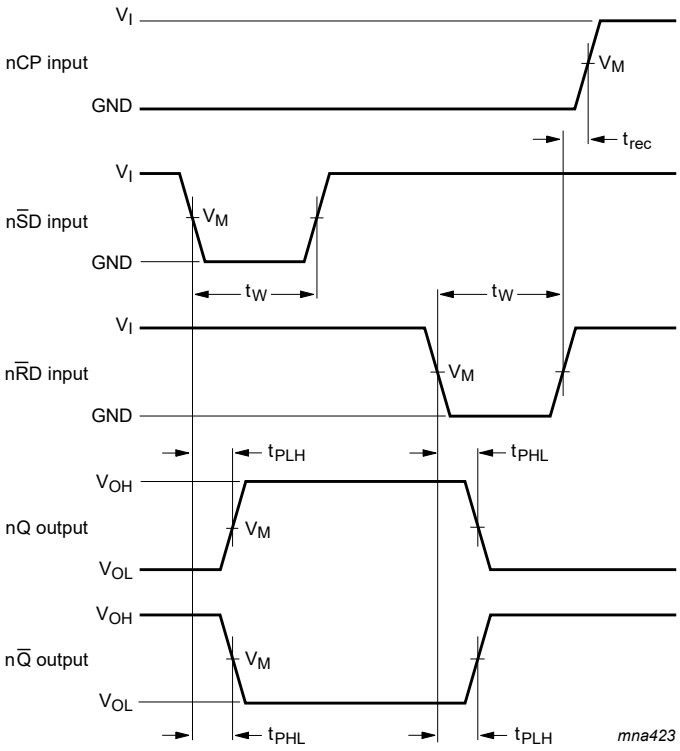


The shaded areas indicate when the input is permitted to change for predictable output performance.

Measurement points are given in Table 9.

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

Fig. 7. The clock input (nCP) to output (nQ, nQ̄) propagation delays, the clock pulse width, the nD to nCP set-up, the nCP to nD hold times, and the maximum frequency



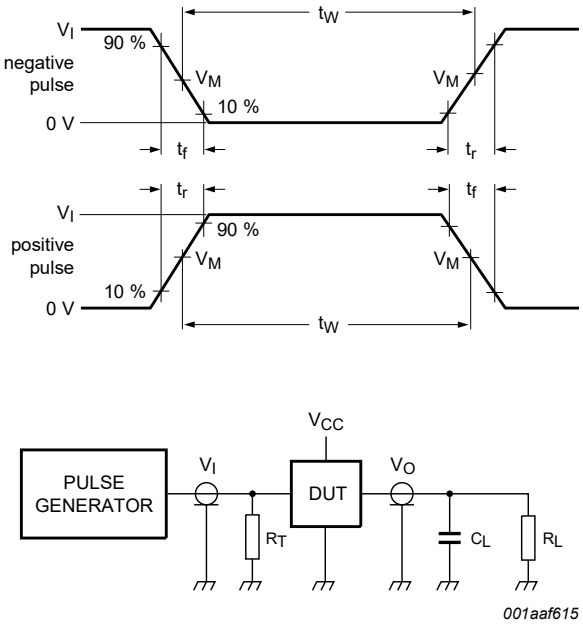
Measurement points are given in Table 9.

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

Fig. 8. The set ($n\overline{SD}$) and reset ($n\overline{RD}$) input to output (nQ, $n\overline{Q}$) propagation delays, the set and reset pulse widths, and the $n\overline{RD}$ to nCP recovery time

Table 9. Measurement points

Supply voltage	Input		Output
V_{CC}	V_I	V_M	V_M
1.2 V	V_{CC}	0.5 x V_{CC}	0.5 x V_{CC}
1.65 V to 1.95 V	V_{CC}	0.5 x V_{CC}	0.5 x V_{CC}
2.3 V to 2.7 V	V_{CC}	0.5 x V_{CC}	0.5 x V_{CC}
2.7 V	2.7 V	1.5 V	1.5 V
3.0 V to 3.6 V	2.7 V	1.5 V	1.5 V



Test data is given in Table 10.

Definitions for test circuit:

R_L = Load resistance.

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.

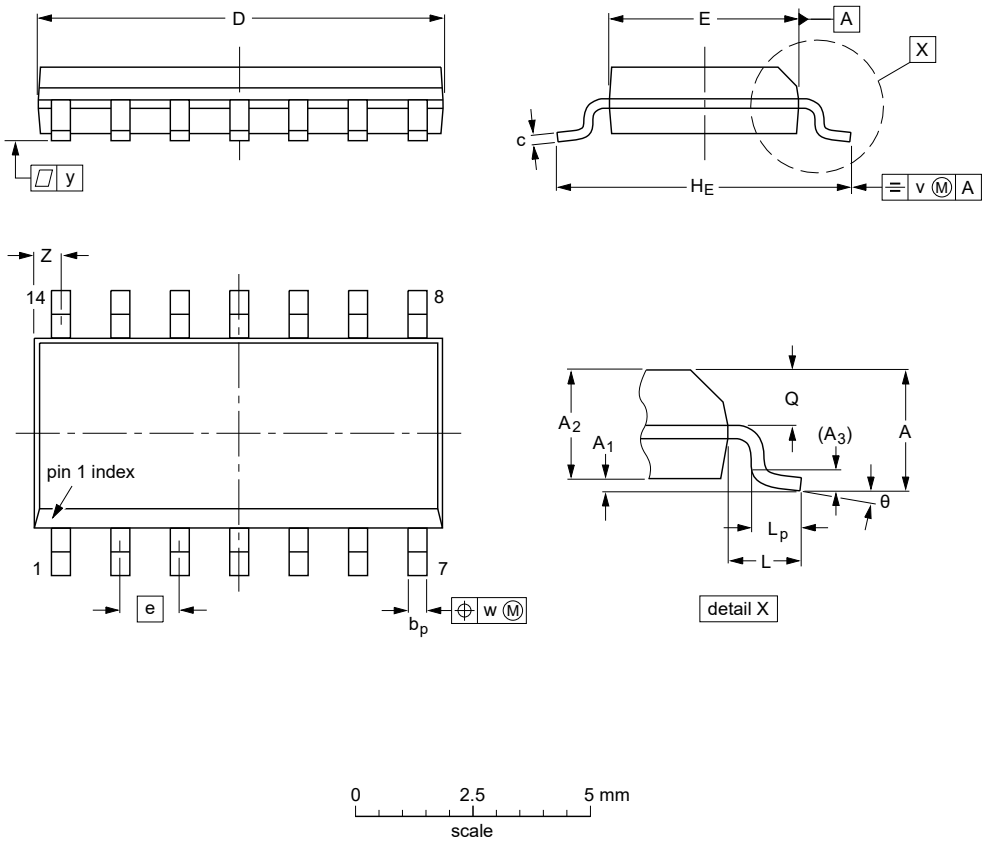
Fig. 9. Test circuit for measuring switching times

Table 10. Test data

Supply voltage	Input		Load	
V_{CC}	V_I	t_r, t_f	C_L	R_L
1.2 V	V_{CC}	≤ 2 ns	30 pF	1 kΩ
1.65 V to 1.95 V	V_{CC}	≤ 2 ns	30 pF	1 kΩ
2.3 V to 2.7 V	V_{CC}	≤ 2 ns	30 pF	500 Ω
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω

11. 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	

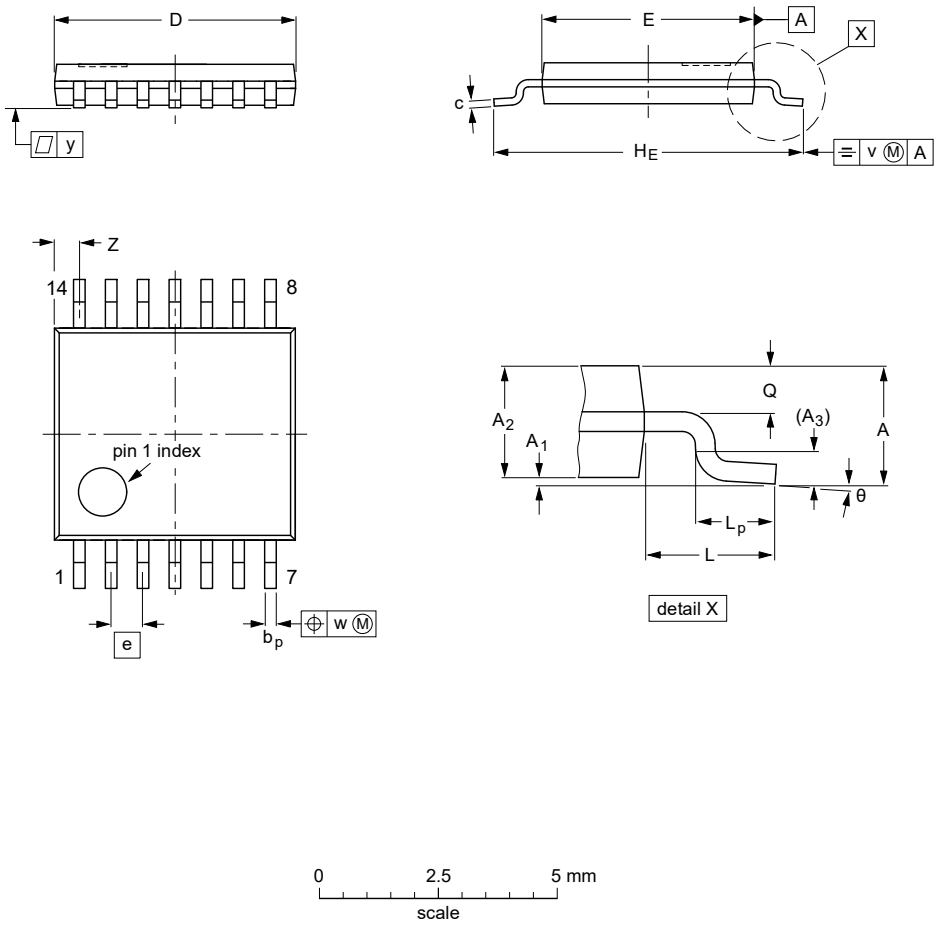
Note

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° 0°

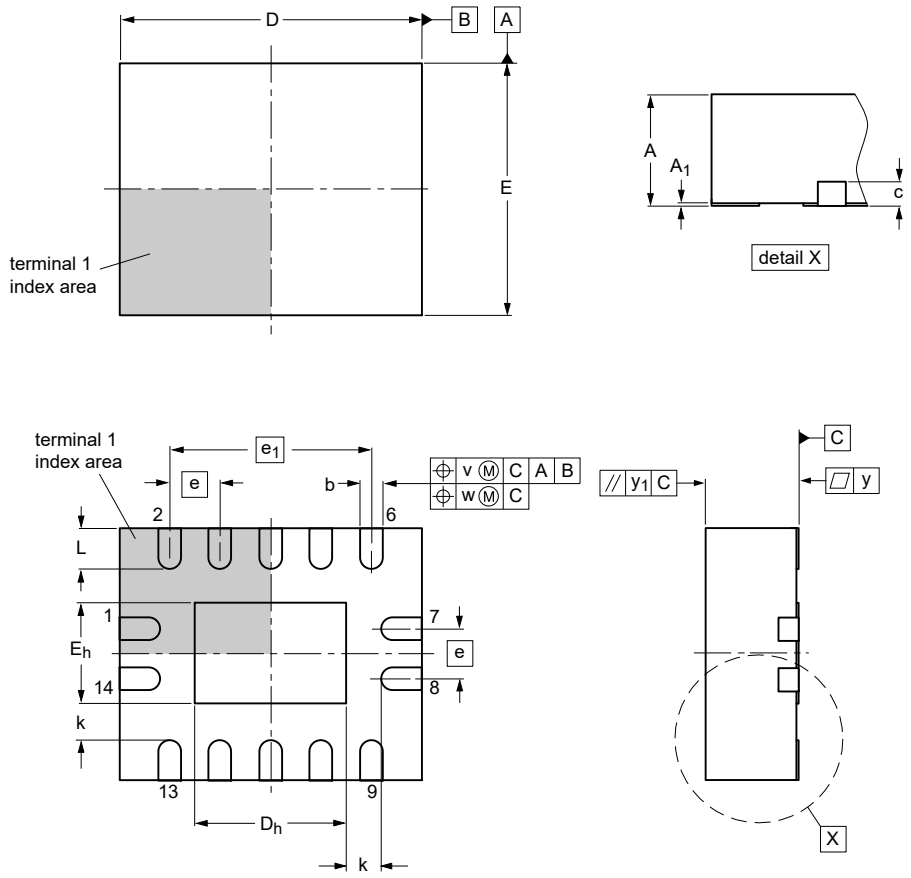
Notes

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		$A^{(1)}$	A_1	b	c	$D^{(1)}$	D_h	$E^{(1)}$	E_h	e	e_1	k	L	v	w	y	y_1
	max	1	0.05	0.30		3.1	1.65	2.6	1.15				0.5				
mm	nom		0.02	0.25	0.2	3.0	1.50	2.5	1.00	0.5	2		0.4	0.1	0.05	0.05	0.1
	min		0.00	0.18		2.9	1.35	2.4	0.85			0.2	0.3				

Note

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

sot762-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT762-1		MO-241				~~15-04-10~~ 15-05-05

Fig. 12. Package outline SOT762-1 (DHVQFN14)

12. Abbreviations

Table 11. Abbreviations

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

13. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC74A v.9	20210820	Product data sheet	-	74LVC74A v.8
Modifications:	• Type number 74LVC74ADB (SOT337-1/SSOP14) removed.			
74LVC74A v.8	20200618	Product data sheet	-	74LVC74A v.7
Modifications:	• 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. • Section 1 and Section 2 updated. • Table 5: Derating values for P_{tot} total power dissipation have been updated. • Table 10 corrected (errata). • Package outline drawing of SOT762-1 (Fig. 12) updated.			
74LVC74A v.7	20121120	Product data sheet	-	74LVC74A v.6
Modifications:	• Table 6, Table 7, Table 8, Table 9 and Table 10: values added for lower voltage ranges.			
74LVC74A v.6	20070604	Product data sheet	-	74LVC74A v.5
74LVC74A v.5	20070525	Product data sheet	-	74LVC74A v.4
74LVC74A v.4	20030526	Product specification	-	74LVC74A v.3
74LVC74A v.3	20020618	Product specification	-	74LVC74A v.2
74LVC74A v.2	19980617	Product specification	-	74LVC74A v.1
74LVC74A v.1	19980617	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.

[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 https://www.nexperia.com.

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