74LVC74A-Q100

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

Rev. 2 — 5 April 2013 Product data sheet

1. General description

The 74LVC74A-Q100 is a dual edge triggered D-type flip-flop. It has 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.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from −40 °C to +85 °C and from −40 °C to +125 °C
- 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
- ESD protection:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- Multiple package options

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVC74AD-Q100	−40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74LVC74APW-Q100	−40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74LVC74ABQ-Q100	−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

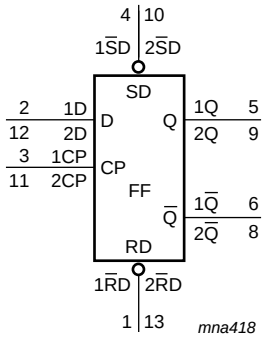


Fig 1. Logic symbol

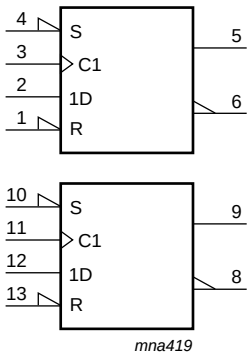


Fig 2. IEC logic symbol

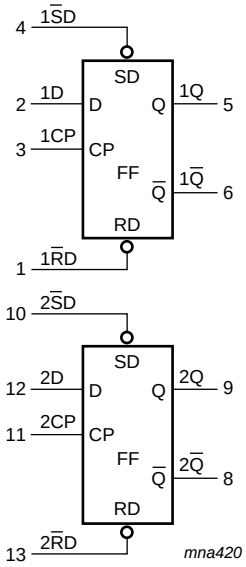


Fig 3. Functional diagram

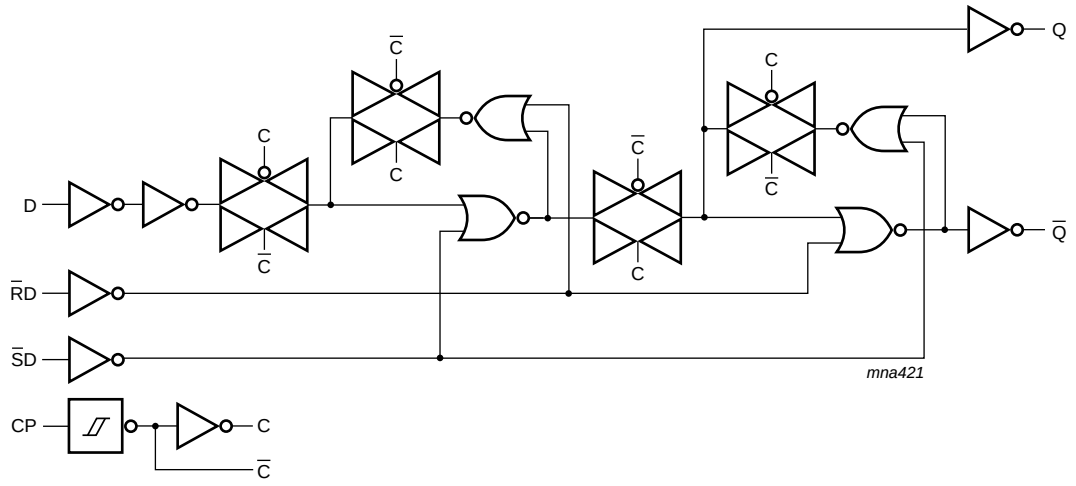


Fig 4. Logic diagram for one flip-flop

5. Pinning information

5.1 Pinning

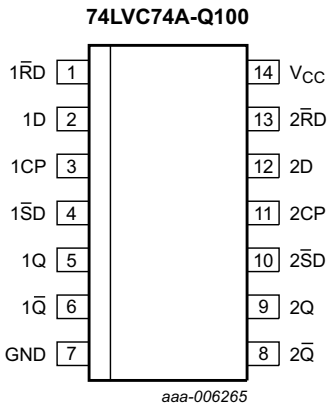
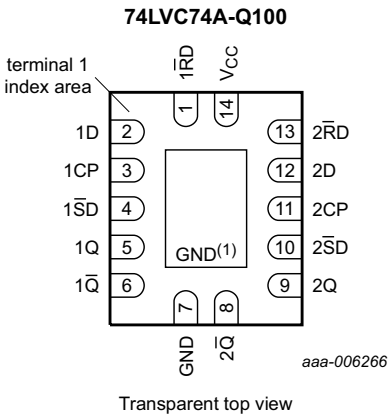


Fig 5. Pin configuration for SO14 and TSSOP14



Transparent top view

(1) This is not a supply pin. The substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land should remain floating or be connected to GND.

Fig 6. Pin configuration for DHVQFN14

5.2 Pin description

Table 2. Pin description

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

6. Functional description

Table 3. Function table[1]

Input				Output	
$n\overline{S}D$	$n\overline{R}D$	nCP	nD	nQ	$n\overline{Q}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H	H

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

Table 4. Function table[1]

Input				Output	
$n\overline{S}D$	$n\overline{R}D$	nCP	nD	nQ_{n+1}	$n\overline{Q}_{n+1}$
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 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 SO14 packages: above 70 °C the value of P_{tot} derates linearly with 8 mW/K.
For TSSOP14 packages: above 60 °C the value of P_{tot} derates linearly with 5.5 mW/K.
For DHVQFN14 packages: above 60 °C the value of P_{tot} derates linearly with 4.5 mW/K.

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	0.65 × V_{CC}	-	-	0.65 × V_{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	-	-	0.35 × V_{CC}	-	0.35 × V_{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
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 Figure 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, nQ̄; see Figure 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
		nSD̄ to nQ, nQ̄; see Figure 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
		nRD̄ to nQ, nQ̄; see Figure 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 Figure 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 Figure 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
t_{rec}	recovery time	set or reset; see Figure 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

Table 8. Dynamic characteristics *...continued*

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

Symbol	Parameter	Conditions	–40 °C to +85 °C			–40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
t_{su}	set-up time	nD to nCP; see Figure 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 Figure 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 Figure 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

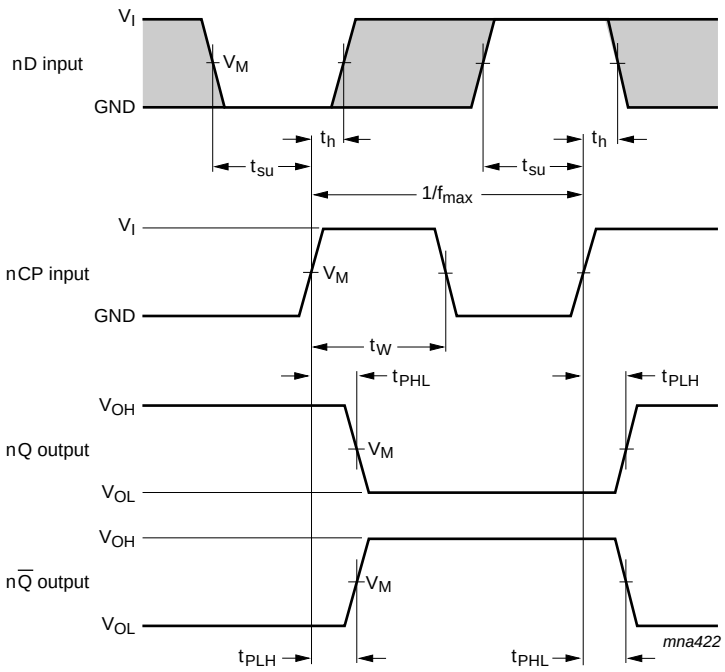
[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.2 V, 1.8 V, 2.5 V, 2.7 V and 3.3 V respectively.

[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

11. AC waveforms

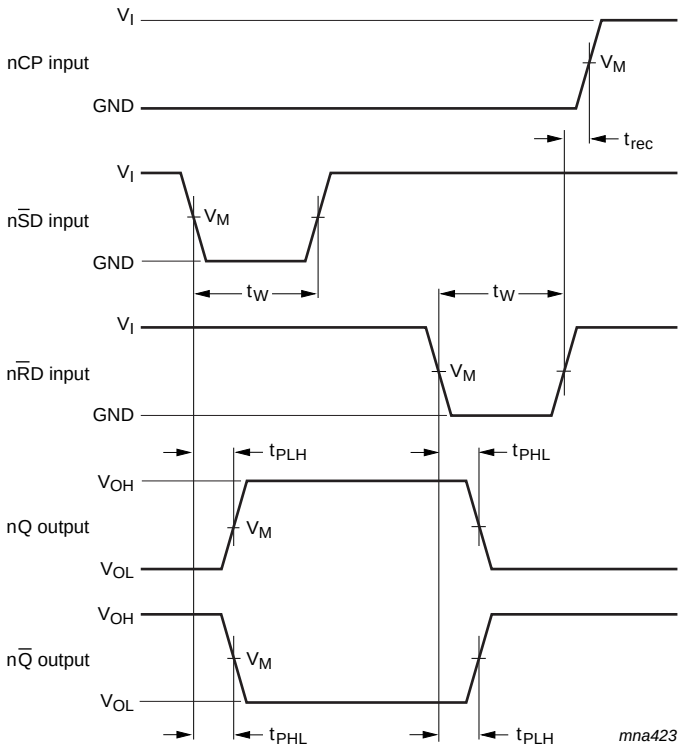


The shaded areas indicate when the input is permitted to change for predictable output performance.

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. Clock propagation delays, pulse widths, set-up, hold times and maximum frequency



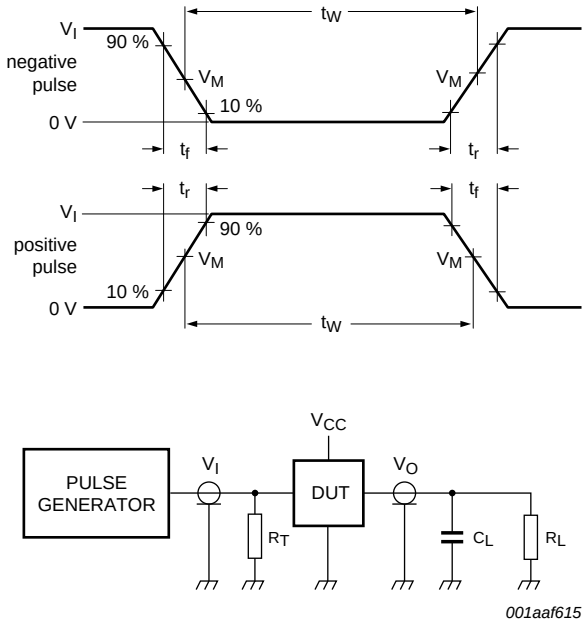
Measurement points are given in Table 9.

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

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

Table 9. Measurement points

Supply voltage	Input		Output
V_{CC}	V_I	V_M	V_M
1.2 V	V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
1.65 V to 1.95 V	V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
2.3 V to 2.7 V	V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
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.

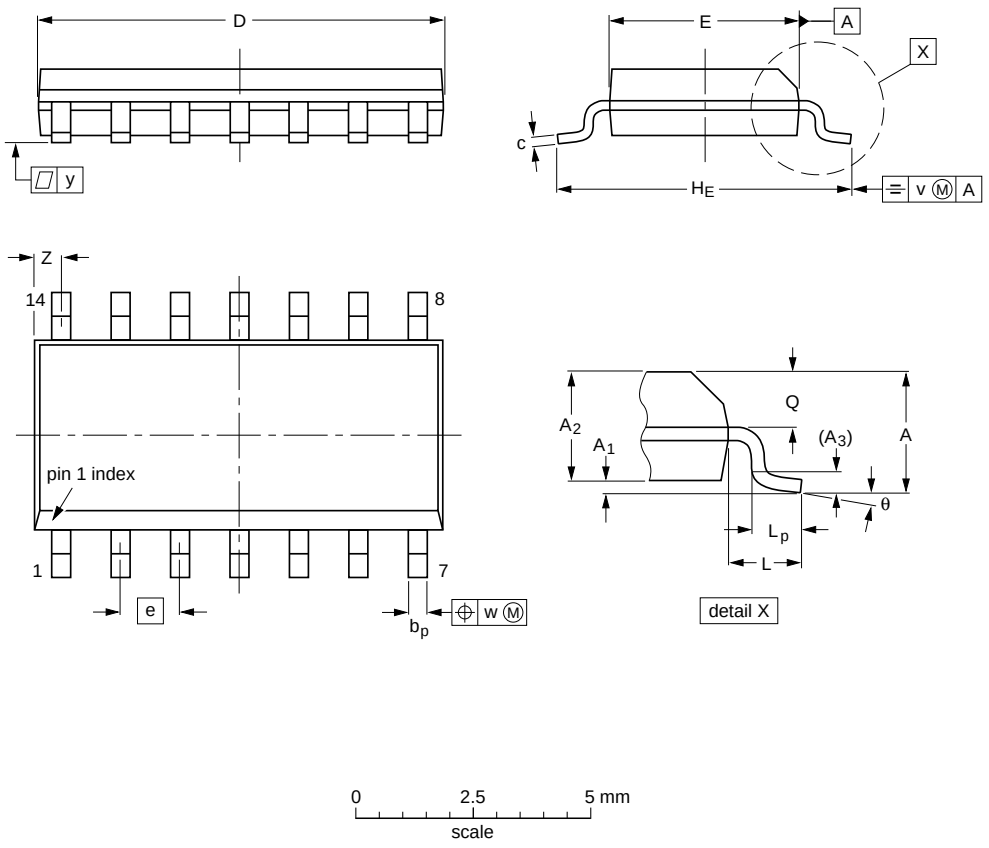
Fig 9. Load circuitry for switching times

Table 10. Test data

Supply voltage	Input		Load		V_{EXT}		
V_{CC}	V_I	t_r, t_f	C_L	R_L	t_{PLH}, t_{PHL}	t_{PLZ}, t_{PZL}	t_{PHZ}, t_{PZH}
1.2 V	V_{CC}	≤ 2 ns	30 pF	1 kΩ	open	2 × V_{CC}	GND
1.65 V to 1.95 V	V_{CC}	≤ 2 ns	30 pF	1 kΩ	open	2 × V_{CC}	GND
2.3 V to 2.7 V	V_{CC}	≤ 2 ns	30 pF	500 Ω	open	2 × V_{CC}	GND
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	2 × V_{CC}	GND
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	2 × V_{CC}	GND

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	

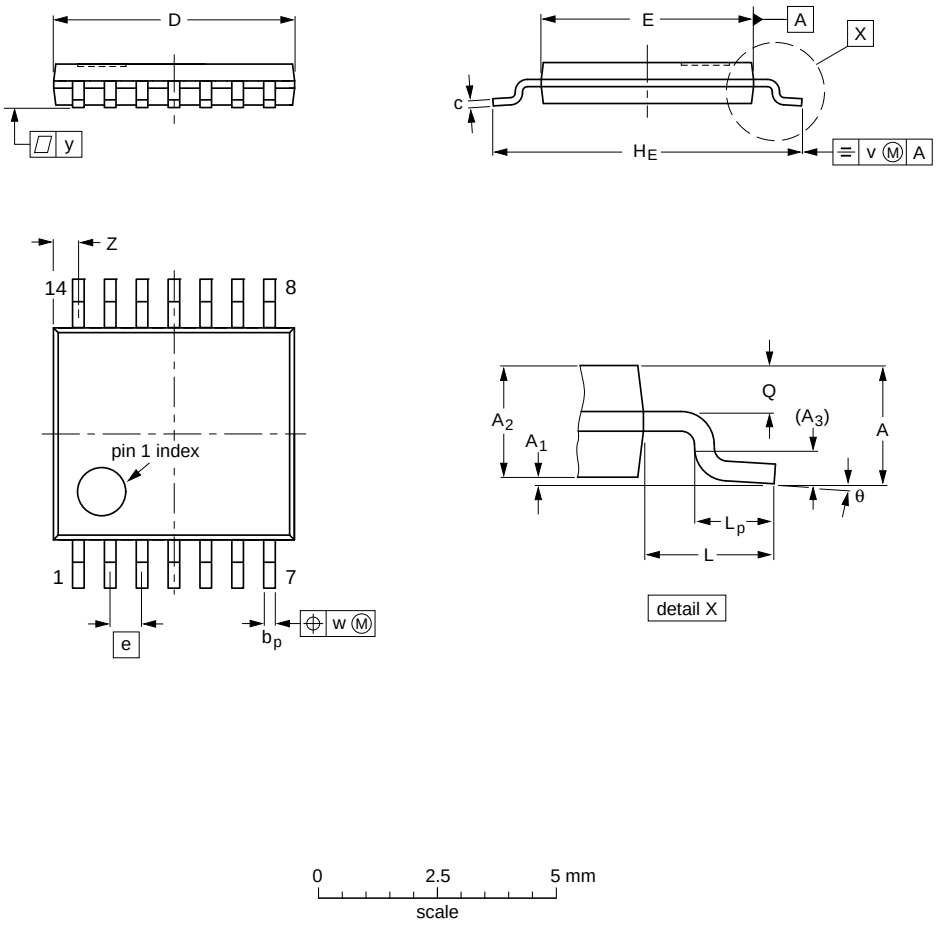
Note

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

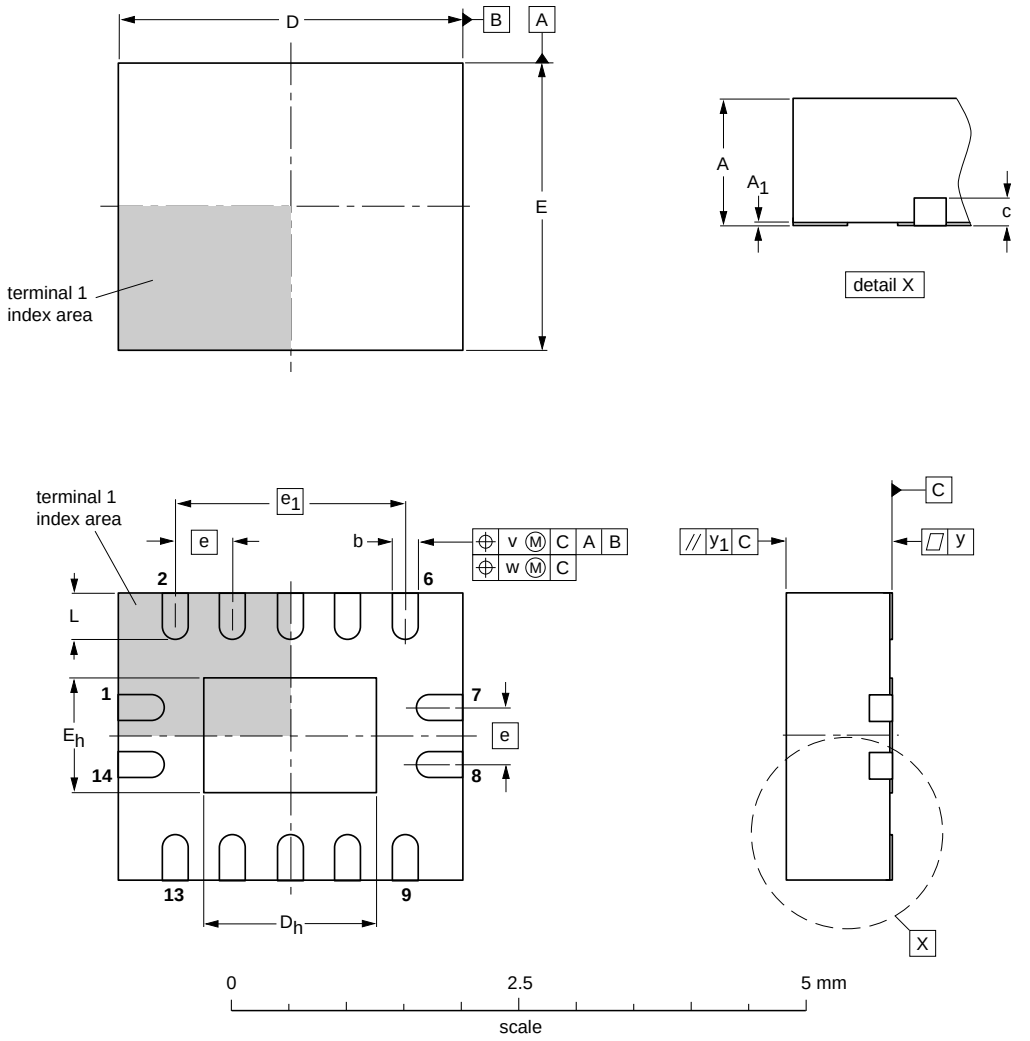
Notes

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 11. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
MIL	Military
TTL	Transistor-Transistor Logic

14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC74A_Q100 v.2	20130405	Product data sheet	-	74LVC74A_Q100 v.1
Modifications:	• Section 2 “Features and benefits” removed redundant temperature range			
74LVC74A_Q100 v.1	20130326	Product data sheet	-	-

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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Date of release: 5 April 2013
Document identifier: 74LVC74A_Q100