74LV74-Q100

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

Rev. 1 — 23 September 2013 **Product data sheet**

1. General description

The 74LV74-Q100 is a dual positive 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 that 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 in the clock input makes the circuit highly tolerant to slower clock 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
- Wide supply voltage range from 1.0 V to 5.5 V
- Optimized for low voltage applications: 1.0 V to 3.6 V
- Direct interface with TTL levels (2.7 V to 3.6 V)
- ESD protection:
  - MIL-STD-833, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LV74D-Q100	–40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74LV74PW-Q100	–40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1

4. Functional diagram

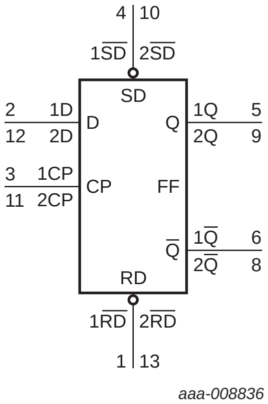


Fig 1. Logic symbol

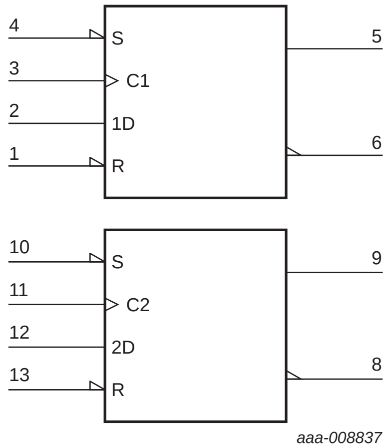


Fig 2. IEC logic symbol

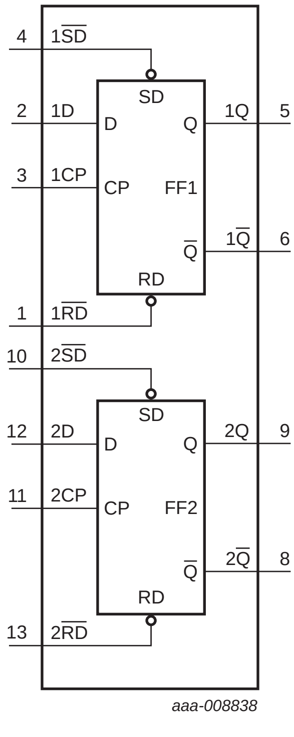


Fig 3. Functional diagram

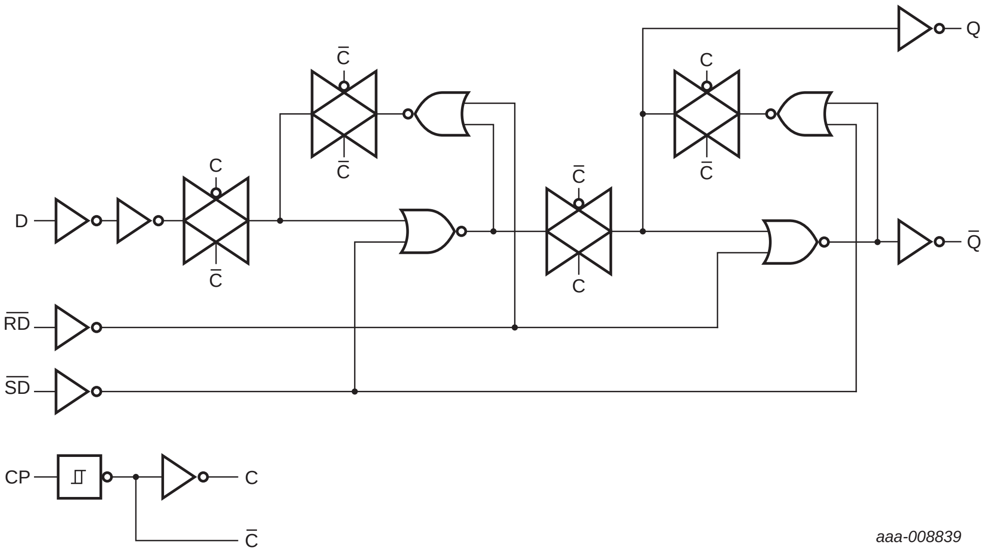


Fig 4. Logic diagram (one flip-flop)

5. Pinning information

5.1 Pinning

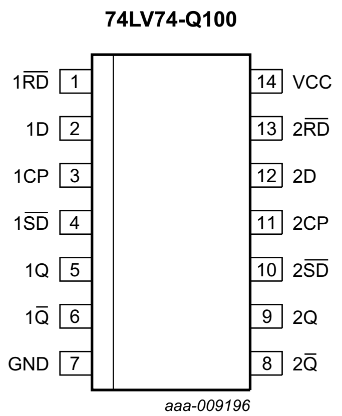


Fig 5. Pin configuration (SO16 and TSSOP16)

5.2 Pin description

Table 2. Pin description

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

6. Functional description

Table 3. Function table[1]

Input				Output			
$n\overline{SD}$	$n\overline{RD}$	nCP	nD	nQ	$n\overline{Q}$	Q_{n+1}	$n\overline{Q}_{n+1}$
L	H	X	X	H	L	-	-
H	L	X	X	L	H	-	-
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;
X = don't care;
↑ = LOW-to-HIGH clock transition;
Q_{n+1} = state after the next LOW-to-HIGH CP transition

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		[1]	–0.5	+7	V
I_{IK}	input clamping current	$V_I < –0.5$ V or $V_I > V_{CC} + 0.5$ V		-	20	mA
V_I	input voltage		[1]	–0.5	+7	V
I_{OK}	output clamping current	$V_O > V_{CC}$ or $V_O < 0$		-	±50	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	T_{amb} = –40 °C to +125 °C				
		SO16 package	[2]	-	500	mW
		TSSOP16 package	[3]	-	400	mW

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

[2] P_{tot} derates linearly with 8 mW/K above 70 °C.

[3] P_{tot} derates linearly with 5.5 mW/K above 60 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage	[1]	1.0	3.3	5.5	V
V_I	input voltage		0	-	V_{CC}	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} = 1.0 V to 2.0 V	0	-	500	ns/V
		V_{CC} = 2.0 V to 2.7 V	0	-	200	ns/V
		V_{CC} = 2.7 V to 3.6 V	0	-	100	ns/V
		V_{CC} = 3.6 V to 5.5 V	0	-	50	ns/V

[1] LV is guaranteed to function down to V_{CC} = 1.0 V (input levels GND or V_{CC}). DC characteristics are guaranteed from V_{CC} = 1.2 V to V_{CC} = 5.5 V.

9. Static characteristics

Table 6. 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	0.9	-	-	0.9	-	V
		V_{CC} = 2.3 V to 2.7 V	1.4	-	-	1.4	-	V
		V_{CC} = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
		V_{CC} = 4.5 V to 5.5 V	0.7 × V_{CC}	-	-	0.7 × V_{CC}	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 1.2 V	-	-	0.3	-	0.3	V
		V_{CC} = 2.3 V to 2.7 V	-	-	0.6	-	0.6	V
		V_{CC} = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V
		V_{CC} = 4.5 V to 5.5 V	-	-	0.3 × V_{CC}	-	0.3 × V_{CC}	
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}; I_O = –100 µA						
		V_{CC} = 1.2 V	-	1.2		-		
		V_{CC} = 2.0 V	1.8	2.0	-	1.8	-	V
		V_{CC} = 2.7 V	2.5	2.7	-	2.5	-	V
		V_{CC} = 3.0 V	2.8	3.0	-	2.8	-	V
		V_{CC} = 4.5 V	4.3	4.5	-	4.3	-	V
		standard outputs: V_I = V_{IH} or V_{IL}						
		V_{CC} = 3.0 V; I_O = –6 mA	2.40	2.82	-	2.20	-	V
		V_{CC} = 4.5 V; I_O = –12 mA	3.60	4.20	-	3.50	-	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}; I_O = 100 µA						
		V_{CC} = 1.2 V	-	0	-	-	-	
		V_{CC} = 2.0 V	-	0	0.2		0.2	V
		V_{CC} = 2.7 V	-	0	0.2		0.2	V
		V_{CC} = 3.0 V	-	0	0.2		0.2	V
		V_{CC} = 4.5 V	-	0	0.2		0.2	V
		standard outputs: V_I = V_{IH} or V_{IL}						
		V_{CC} = 3.0 V; I_O = 6 mA	-	0.25	0.40	-	0.50	V
		V_{CC} = 4.5 V; I_O = 12 mA	-	0.35	0.55	-	0.65	V
I_I	input leakage current	V_I = V_{CC} or GND; V_{CC} = 5.5 V	-	-	±1	-	±1	µA
I_{CC}	supply current	V_I = V_{CC} or GND; I_O = 0 A; V_{CC} = 5.5 V	-	-	20	-	80	µA
ΔI_{CC}	additional supply current	VI = V_{CC} – 0.6 V; V_{CC} = 2.7 V to 3.6 V	-	-	500	-	850	µA
C_I	input capacitance		-	3.5	-			pF

[1] Typical values are measured at T_{amb} = 25 °C.

10. Dynamic characteristics

Table 7. Dynamic characteristics

GND (ground = 0 V): for test circuit, see Figure 8

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 Figure 6 [2]						
		V_{CC} = 1.2 V	-	70	-	-	-	ns
		V_{CC} = 2.0 V	-	24	44	-	56	ns
		V_{CC} = 2.7 V	-	18	28	-	41	ns
		V_{CC} = 3.0 V to 3.6 V [3]	-	13	26	-	33	ns
		V_{CC} = 3.3 V; C_L = 15 pF	-	11	-	-	-	ns
		V_{CC} = 4.5 V to 5.5 V [4]	-	9.5	17	-	23	ns
		$n\overline{SD}$ to nQ, $n\overline{Q}$; see Figure 7						
		V_{CC} = 1.2 V	-	90	-	-	-	ns
		V_{CC} = 2.0 V	-	31	46	-	58	ns
		V_{CC} = 2.7 V	-	23	34	-	43	ns
		V_{CC} = 3.0 V to 3.6 V [3]	-	17	27	-	34	ns
		V_{CC} = 3.3 V; C_L = 15 pF	-	14	-	-	-	ns
		V_{CC} = 4.5 V to 5.5 V [4]	-	12	19	-	24	ns
		$n\overline{RD}$ to nQ, $n\overline{Q}$; see Figure 7						
		V_{CC} = 1.2 V	-	90	-	-	-	ns
		V_{CC} = 2.0 V	-	31	46	-	58	ns
		V_{CC} = 2.7 V	-	23	34	-	43	ns
		V_{CC} = 3.0 V to 3.6 V [3]	-	17	27	-	34	ns
		V_{CC} = 3.3 V; C_L = 15 pF	-	14	-	-	-	ns
		V_{CC} = 4.5 V to 5.5 V [4]	-	12	19	-	24	ns
t_W	pulse width	nCP input HIGH to LOW; see Figure 6						
		V_{CC} = 2.0 V	34	10	-	41	-	ns
		V_{CC} = 2.7 V	25	8	-	30	-	ns
		V_{CC} = 3.0 V to 3.6 V [3]	20	7	-	24	-	ns
		V_{CC} = 4.5 V to 5.5 V [4]	15	6	-	18	-	ns
		$n\overline{SD}$ or $n\overline{RD}$ pulse width LOW; see Figure 7						
		V_{CC} = 2.0 V	34	10	-	41	-	ns
		V_{CC} = 2.7 V	25	8	-	30	-	ns
		V_{CC} = 3.0 V to 3.6 V [3]	20	7	-	24	-	ns
		V_{CC} = 4.5 V to 5.5 V [4]	15	6	-	18	-	ns

Table 7. Dynamic characteristics *...continued*

GND (ground = 0 V): for test circuit, see Figure 8

Symbol	Parameter	Conditions		−40 °C to +85 °C			−40 °C to +125 °C		Unit
				Min	Typ[1]	Max	Min	Max	
t_{rec}	recovery time	$n\overline{RD}$; see Figure 7							
		V_{CC} = 1.2 V		-	5	-	-	-	ns
		V_{CC} = 2.0 V		14	2	-	15	-	ns
		V_{CC} = 2.7 V		10	1	-	11	-	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	8	1	-	9	-	ns
		V_{CC} = 4.5 V to 5.5 V	[4]	6	1	-	7	-	ns
t_{su}	set-up time	nD to nCP; see Figure 6							
		V_{CC} = 1.2 V		-	10	-	-	-	ns
		V_{CC} = 2.0 V		22	4	-	26	-	ns
		V_{CC} = 2.7 V		12	3	-	15	-	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	8	2	-	10	-	ns
		V_{CC} = 4.5 V to 5.5 V	[4]	6	1	-	8	-	ns
t_h	hold time	nD to nCP; see Figure 6							
		V_{CC} = 1.2 V		-	−10	-	-	-	ns
		V_{CC} = 2.0 V		3	−2	-	3	-	ns
		V_{CC} = 2.7 V		3	−2	-	3	-	ns
		V_{CC} = 3.0 V to 3.6 V		3	−2	-	3	-	ns
		V_{CC} = 4.5 V to 5.5 V		3	−2	-	3	-	ns
f_{max}	maximum frequency	nCP; see Figure 6							
		V_{CC} = 2.0 V		14	40	-	12	-	MHz
		V_{CC} = 2.7 V		50	90	-	40	-	MHz
		V_{CC} = 3.0 V to 3.6 V	[3]	60	100	-	48	-	MHz
		V_{CC} = 4.5 V to 5.5 V	[4]	70	110	-	56	-	MHz
C_{PD}	power dissipation capacitance	V_I = GND to V_{CC}	[5]	-	24	-	-	-	pF

[1] Typical values are measured at T_{amb} = 25 °C.

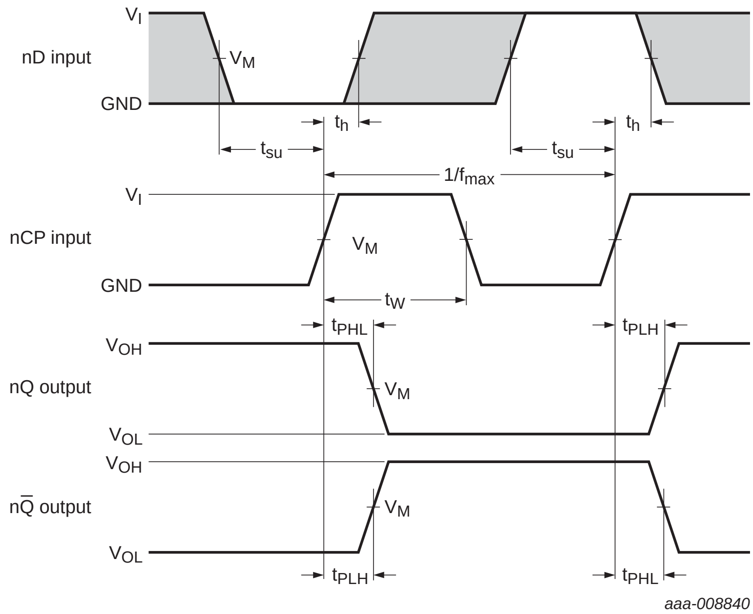
[2] t_{pd} is the same as t_{PHL} and t_{PLH}.

[3] Typical value measured at V_{CC} = 3.3 V.

[4] Typical values are measured at V_{CC} = 5.0 V.

[5] C_{PD} is used to determine the dynamic power dissipation $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma (C_L \times V_{CC}^2 \times f_o)$ (P_D in μW), where:
f_i = input frequency in MHz;
f_o = output frequency in MHz;
$\Sigma (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs;
C_L = output load capacitance in pF;
V_{CC} = supply voltage in V.

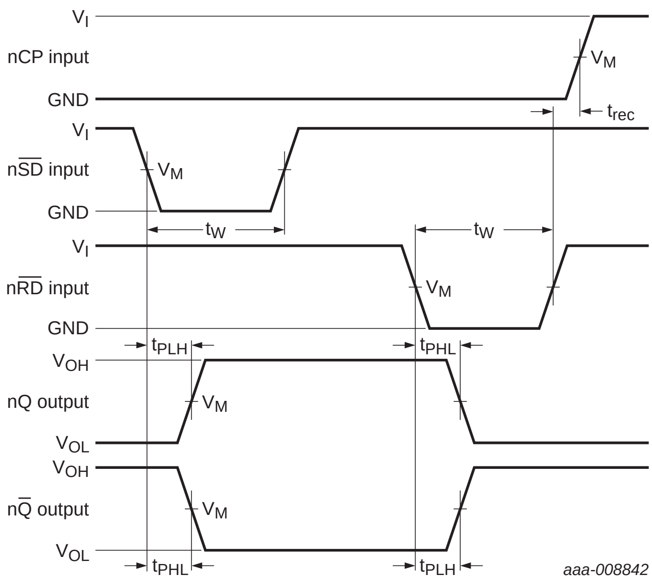
11. Waveforms



Measurement points are given in Table 8.

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

Fig 6. Clock pulse (nCP) to output (nQ, $n\overline{Q}$) propagation delays, nCP pulse width and maximum frequency

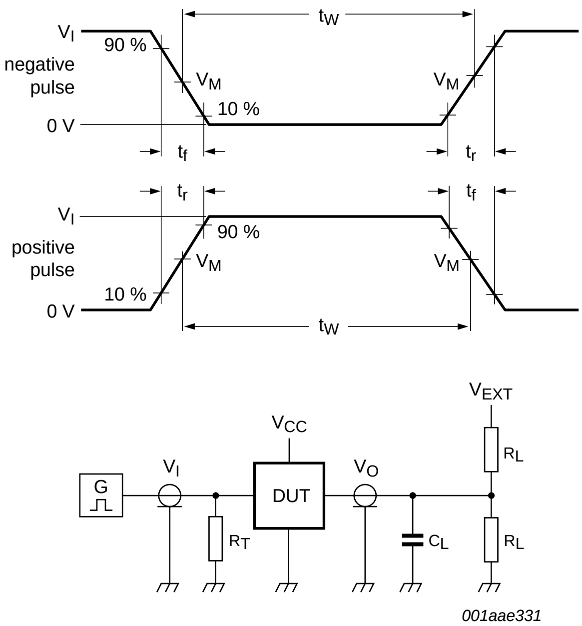


Measurement points are given in Table 8.

Fig 7. Set ($n\overline{SD}$) and reset ($n\overline{RD}$) input to output (nQ, $n\overline{Q}$) propagation delays, pulse widths and $n\overline{RD}$ to nCP recovery time

Table 8. Measurement points

Supply voltage	Input	Output
V_{CC}	V_M	V_M
< 2.7 V	$0.5V_{CC}$	$0.5V_{CC}$
2.7 V to 3.6 V	1.5 V	1.5 V
≥ 4.5 V	$0.5V_{CC}$	$0.5V_{CC}$



Test data is given in Table 9.

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.

V_{EXT} = External voltage for measuring switching times.

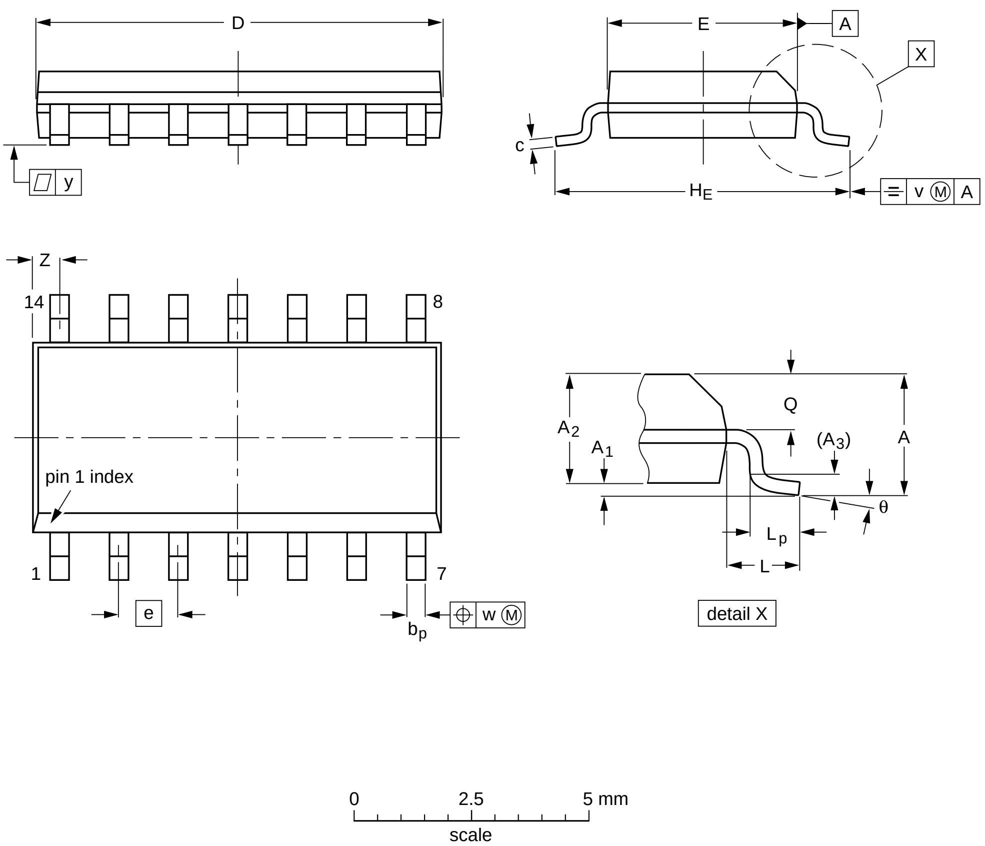
Fig 8. Test circuit for measuring switching times

Table 9. Test data

Supply voltage	Input		Load		V_{EXT}
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}
< 2.7 V	V_{CC}	2.5 ns	50 pF	1 kΩ	open
2.7 V to 3.6 V	2.7 V	2.5 ns	50 pF, 15 pF	1 kΩ	open
≥ 4.5 V	V_{CC}	2.5 ns	50 pF	1 kΩ	open

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° 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	

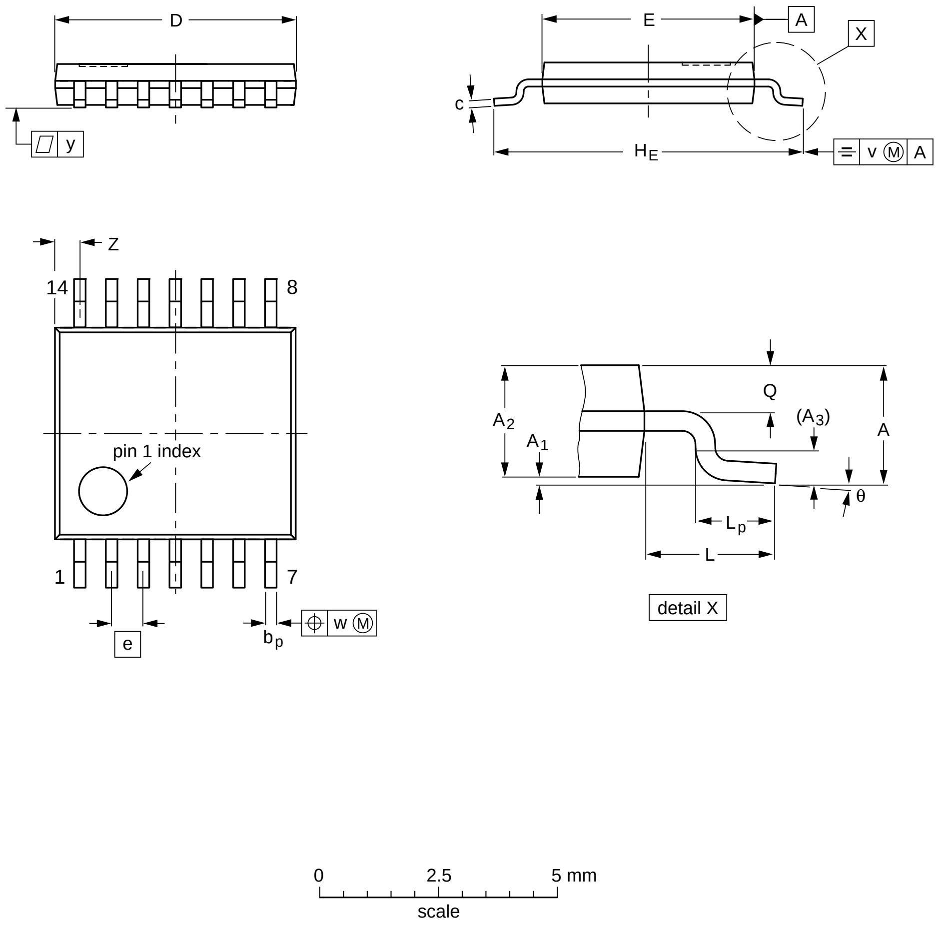
Note

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 9. 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 10. Package outline SOT402-1 (TSSOP14)

13. Abbreviations

Table 10. Abbreviations

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

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LV74_Q100 v.1	20130923	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.nexperia.com.

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16. Contact information

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17. Contents

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Общество с ограниченной ответственностью «МосЧип» ИНН 7719860671 / КПП 771901001
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