74VHC125; 74VHCT125

Quad buffer/line driver; 3-state

Rev. 02 — 13 October 2009 Product data sheet

1. General description

The 74VHC125; 74VHCT125 are high-speed Si-gate CMOS devices and are pin compatible with Low-power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard JESD7-A.

The 74VHC125; 74VHCT125 provides four non-inverting buffer/line drivers with 3-state outputs. The 3-state outputs (nY) are controlled by the output enable input ($n\overline{OE}$). A HIGH at $n\overline{OE}$ causes the outputs to assume a high-impedance OFF-state.

The 74VHC125; 74VHCT125 are identical to the 74VHC126; 74VHCT126 but have active LOW enable inputs.

2. Features

- Balanced propagation delays
- All inputs have a Schmitt-trigger action
- Inputs accepts voltages higher than V_{CC}
- Input levels:
  - The 74VHC125 operates with CMOS logic levels
  - The 74VHCT125 operates with TTL logic levels
- ESD protection:
  - HBM JESD22-A114E exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
  - CDM 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
74VHC125D	–40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74VHCT125D				
74VHC125PW	–40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74VHCT125PW				
74VHC125BQ	–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
74VHCT125BQ				

4. Functional diagram

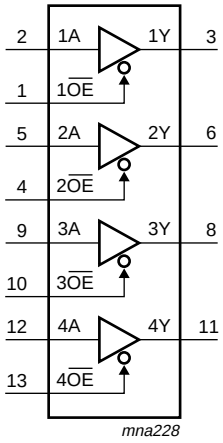


Fig 1. Logic symbol

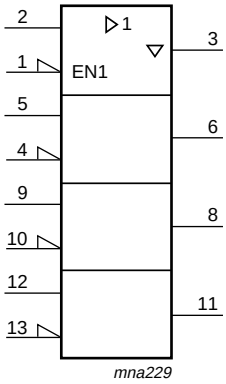


Fig 2. IEC logic symbol

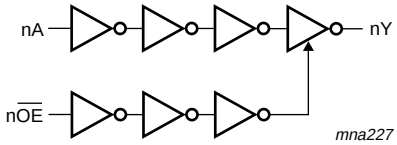


Fig 3. Logic diagram (one buffer)

5. Pinning information

5.1 Pinning

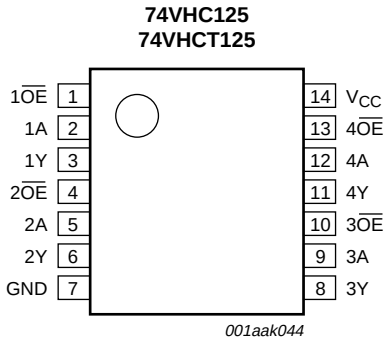
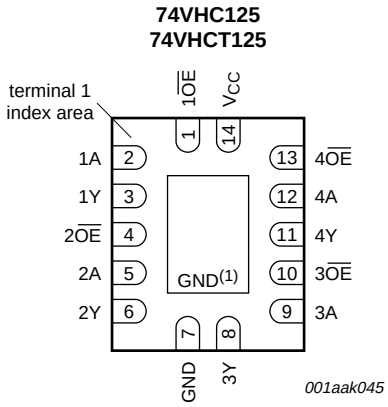


Fig 4. Pin configuration SO14 and TSSOP14



Transparent top view

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

Fig 5. Pin configuration DHVQFN14

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$1\overline{OE}$, $2\overline{OE}$, $3\overline{OE}$, $4\overline{OE}$	1, 4, 10, 13	output enable input (active LOW)
1A, 2A, 3A, 4A	2, 5, 9, 12	data input
1Y, 2Y, 3Y, 4Y	3, 6, 8, 11	data output
GND	7	ground (0 V)
V_{CC}	14	supply voltage

6. Functional description

Table 3. Function table[1]

Control	Input	Output
$n\overline{OE}$	**nA**	**nY**
L	L	L
	H	H
H	X	Z

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state.

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	mA
I_O	output current	$V_O = -0.5$ V to $(V_{CC} + 0.5$ V)		-	±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				
	SO14 package		[2]	-	500	mW
	TSSOP14 package		[3]	-	500	mW
	DHVQFN14 package		[4]	-	500	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.

[4] P_{tot} derates linearly with 4.5 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	74VHC125			74VHCT125			Unit
			Min	Typ	Max	Min	Typ	Max	
V_{CC}	supply voltage		2.0	5.0	5.5	4.5	5.0	5.5	V
V_I	input voltage		0	-	5.5	0	-	5.5	V
V_O	output voltage		0	-	V_{CC}	0	-	V_{CC}	V
T_{amb}	ambient temperature		–40	+25	+125	–40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CC} = 3.3 V ± 0.3 V	-	-	100	-	-	-	ns/V
		V_{CC} = 5.0 V ± 0.5 V	-	-	20	-	-	20	ns/V

9. Static characteristics

Table 6. Static characteristics

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	
For type 74VHC125										
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	-	-	3.8	-	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
I_{OZ}	OFF-state output current	V_I = V_{IH} or V_{IL}; V_O = V_{CC} or GND; V_{CC} = 5.5 V	-	-	±0.25	-	±2.5	-	±10.0	µA
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

Table 6. Static characteristics *…continued*

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	
C_I	input capacitance		-	3.0	10	-	10	-	10	pF
C_O	output capacitance		-	4.0	-	-	-	-	-	pF
For type 74VHCT125										
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	-	-	3.8	-	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_{OZ}	OFF-state output current	per input pin; V_I = V_{IH} or V_{IL}; V_{CC} = 5.5 V; I_O = 0 A V_O = V_{CC} or GND; other pins at V_{CC} or GND	-	-	±0.25	-	±2.5	-	±10.0	μA
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; I_O = 0 A; other pins at V_{CC} or GND; V_{CC} = 4.5 V to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
C_I	input capacitance		-	3.0	10	-	10	-	10	pF
C_O	output capacitance		-	4.0	-	-	-	-	-	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

GND = 0 V; For test circuit see Figure 8.

Symbol	Parameter	Conditions		25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit
				Min	Typ[1]	Max	Min	Max	Min	Max	
For type 74VHC125											
t_{pd}	propagation delay	nA to nY; see Figure 6	[2]								
		V_{CC} = 3.0 V to 3.6 V									
		C_L = 15 pF		-	4.4	8.0	1.0	9.5	1.0	11.5	ns
		C_L = 50 pF		-	6.2	11.5	1.0	13.0	1.0	14.5	ns
		V_{CC} = 4.5 V to 5.5 V									
		C_L = 15 pF		-	3.0	5.5	1.0	6.5	1.0	7.0	ns
		C_L = 50 pF		-	4.3	7.5	1.0	8.5	1.0	9.5	ns
t_{en}	enable time	$n\overline{OE}$ to nY; see Figure 7	[2]								
		V_{CC} = 3.0 V to 3.6 V									
		C_L = 15 pF		-	4.7	8.0	1.0	9.5	1.0	11.5	ns
		C_L = 50 pF		-	6.8	11.5	1.0	13.0	1.0	14.5	ns
		V_{CC} = 4.5 V to 5.5 V									
		C_L = 15 pF		-	3.3	5.1	1.0	6.0	1.0	6.5	ns
		C_L = 50 pF		-	4.7	7.1	1.0	8.0	1.0	9.0	ns
t_{dis}	disable time	$n\overline{OE}$ to nY; see Figure 7	[2]								
		V_{CC} = 3.0 V to 3.6 V									
		C_L = 15 pF		-	6.7	9.7	1.0	11.5	1.0	12.5	ns
		C_L = 50 pF		-	9.6	13.2	1.0	15.0	1.0	16.5	ns
		V_{CC} = 4.5 V to 5.5 V									
		C_L = 15 pF		-	4.8	6.8	1.0	8.0	1.0	8.5	ns
		C_L = 50 pF		-	6.8	8.8	1.0	10.0	1.0	11.0	ns
C_{PD}	power dissipation capacitance	C_L = 50 pF; f_i = 1 MHz; V_I = GND to V_{CC}	[3]	-	10	-	-	-	-	-	pF

Table 7. Dynamic characteristics *…continued*

GND = 0 V; For test circuit see Figure 8.

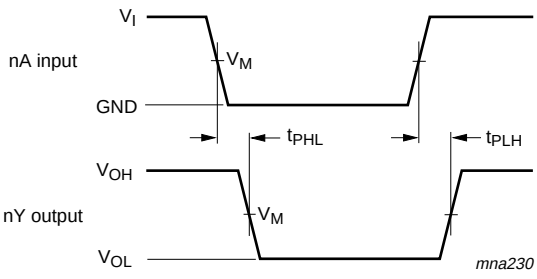
Symbol	Parameter	Conditions		25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit
				Min	Typ[1]	Max	Min	Max	Min	Max	
For type 74VHCT125											
t_{pd}	propagation delay	nA to nY; see Figure 6	[2]								
		V_{CC} = 4.5 V to 5.5 V									
		C_L = 15 pF		-	3.0	5.5	1.0	6.5	1.0	7.0	ns
		C_L = 50 pF		-	4.3	7.5	1.0	8.5	1.0	9.5	ns
t_{en}	enable time	$n\overline{OE}$ to nY; see Figure 7									
		V_{CC} = 4.5 V to 5.5 V									
		C_L = 15 pF		-	3.4	5.1	1.0	6.0	1.0	6.5	ns
		C_L = 50 pF		-	4.9	7.3	1.0	8.3	1.0	9.5	ns
t_{dis}	disable time	$n\overline{OE}$ to nY; see Figure 7	[2]								
		V_{CC} = 4.5 V to 5.5 V									
		C_L = 15 pF		-	4.5	6.8	1.0	8.0	1.0	8.5	ns
		C_L = 50 pF		-	6.5	8.8	1.0	10.0	1.0	11.0	ns
C_{PD}	power dissipation capacitance	C_L = 50 pF; f_i = 1 MHz; V_I = GND to V_{CC}	[3]	-	12	-	-	-	-	-	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}.
t_{en} is the same as t_{PZL} and t_{PZH}.
t_{dis} is the same as t_{PLZ} and t_{PHZ}.

[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 Volts
N = number of inputs switching
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

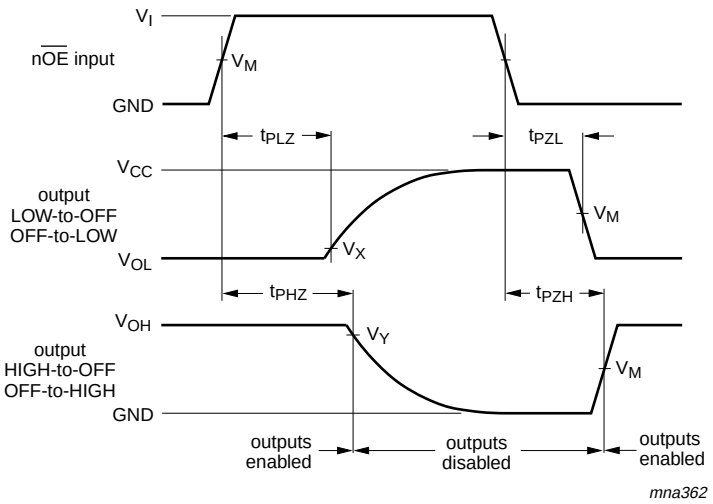
11. Waveforms



Measurement points are given in Table 8.

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

Fig 6. Propagation delay input (nA) to output (nY)



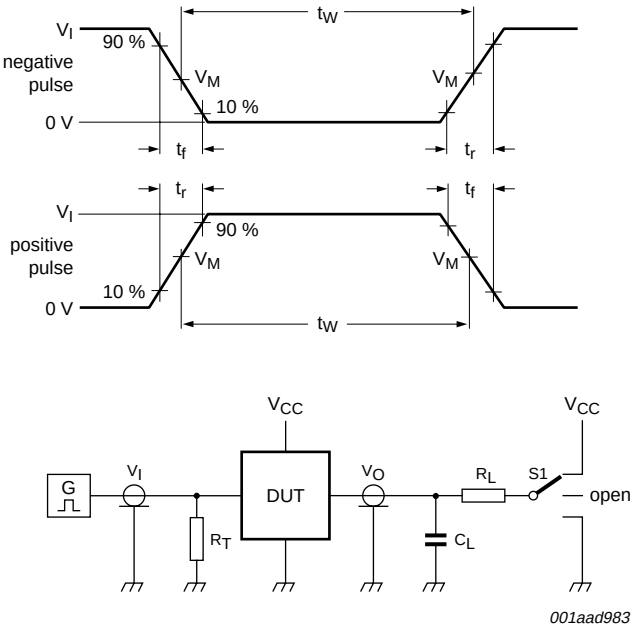
Measurement points are given in Table 8.

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

Fig 7. Enable and disable times

Table 8. Measurement points

Type	Input	Output		
	V_M	V_M	V_X	V_Y
74VHC125	$0.5V_{CC}$	$0.5V_{CC}$	V_{OL} + 0.3 V	V_{OL} – 0.3 V
74VHCT125	1.5 V	$0.5V_{CC}$	V_{OL} + 0.3 V	V_{OL} – 0.3 V



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.

R_L = Load resistance.

S1 = Test selection switch.

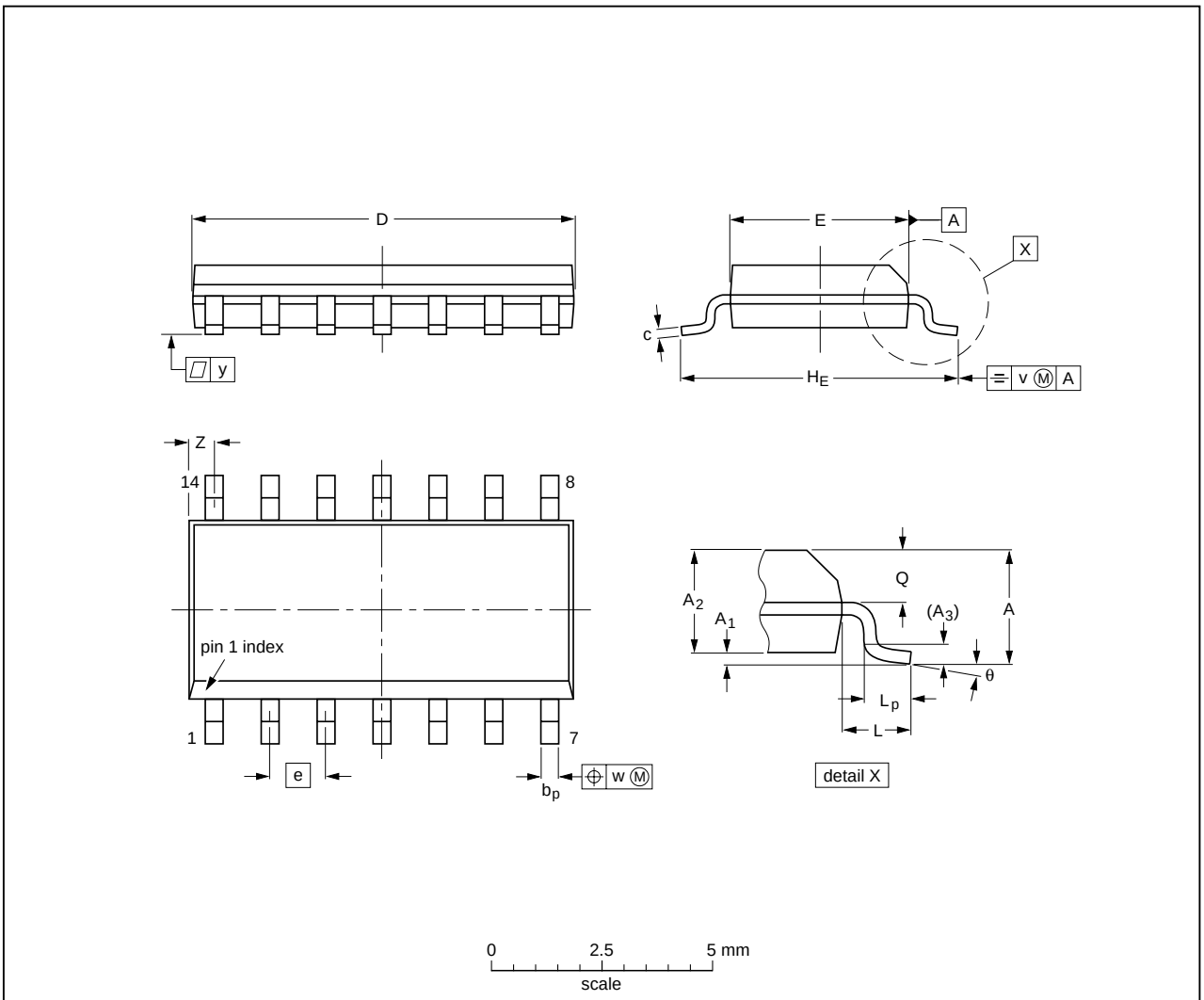
Fig 8. Load circuit for switching times

Table 9. Test data

Type	Input		Load		S1 position		
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
74VHC125	V_{CC}	≤ 3.0 ns	15 pF, 50 pF	1 kΩ	open	GND	V_{CC}
74VHCT125	3.0 V	≤ 3.0 ns	15 pF, 50 pF	1 kΩ	open	GND	V_{CC}

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	

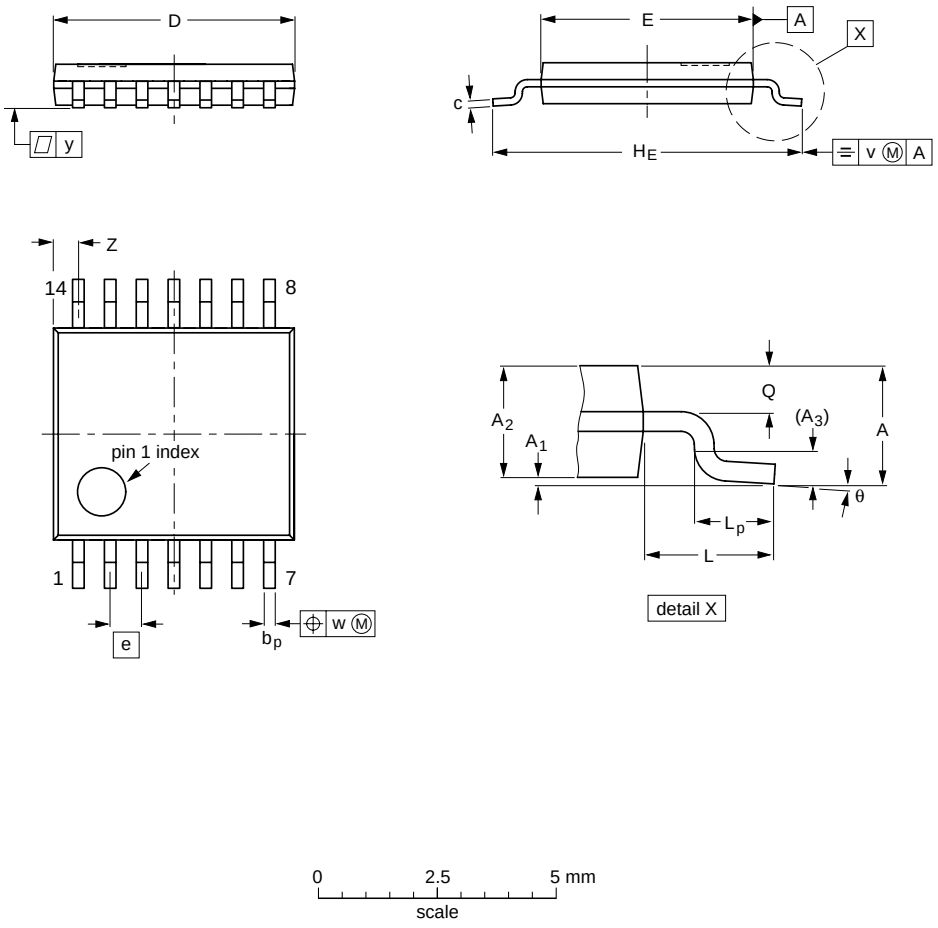
Note

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 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

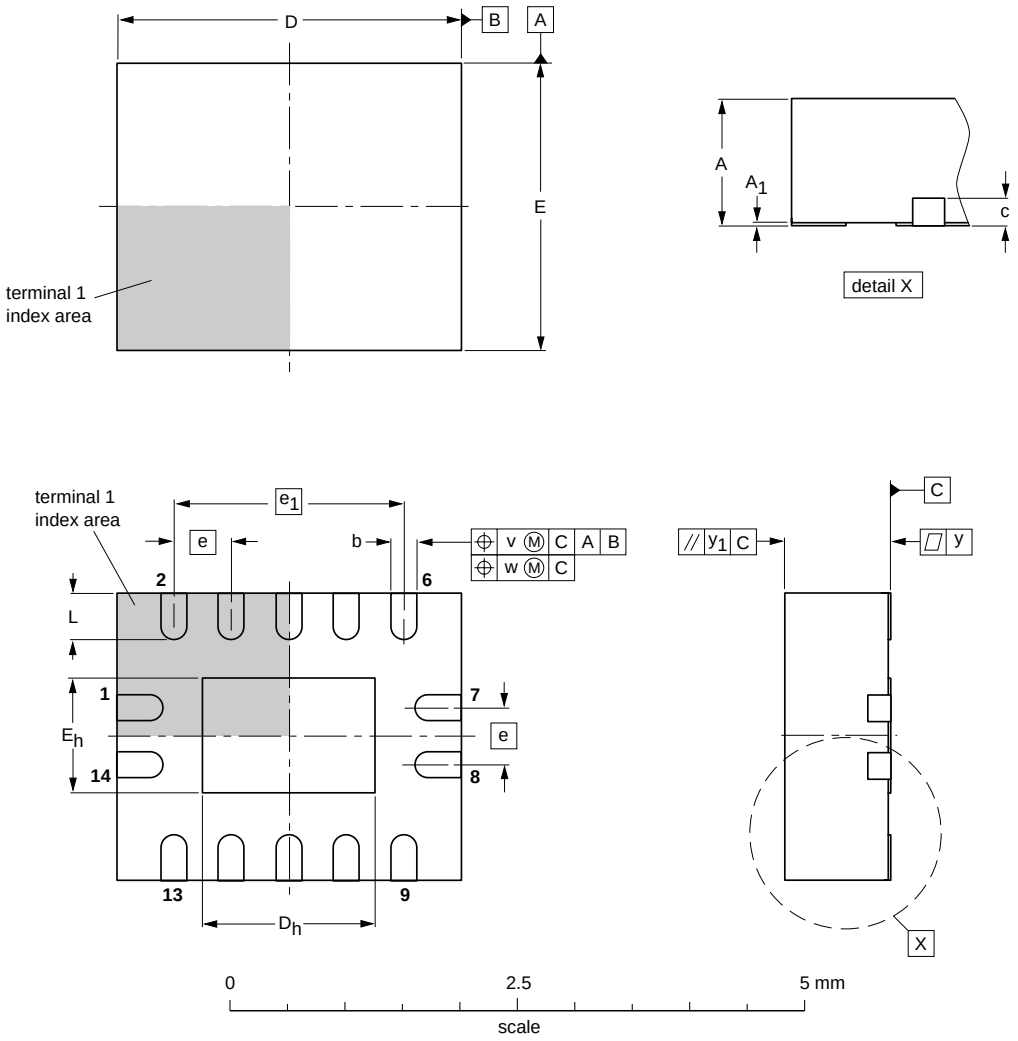
Notes

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)

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 11. Package outline SOT762-1 (DHVQFN14)

13. Abbreviations

Table 10. Abbreviations

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

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74VHC_VHCT125_2	20091013	Product data sheet	-	74VHC_VHCT125_1
Modifications:	• Errata in features list corrected.			
74VHC_VHCT125_1	20090630	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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