

74LVC14A-Q100

Hex inverting Schmitt trigger with 5 V tolerant input

Rev. 3 — 24 July 2020

Product data sheet

1. General description

The 74LVC14A-Q100 is a hex inverter with Schmitt-trigger inputs. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V environments.

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 1.2 V to 3.6 V
- 5 V tolerant input for interfacing with 5 V logic
- CMOS low-power consumption
- Direct interface with TTL levels
- Unlimited input rise and fall times
- Inputs accept voltages up to 5.5 V
- Complies with JEDEC standard JESD8-C/JESD36 (2.7 V to 3.6 V)
- 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
- DHVQFN package with Side-Wettable Flanks enabling Automatic Optical Inspection (AOI) of solder joints

3. Applications

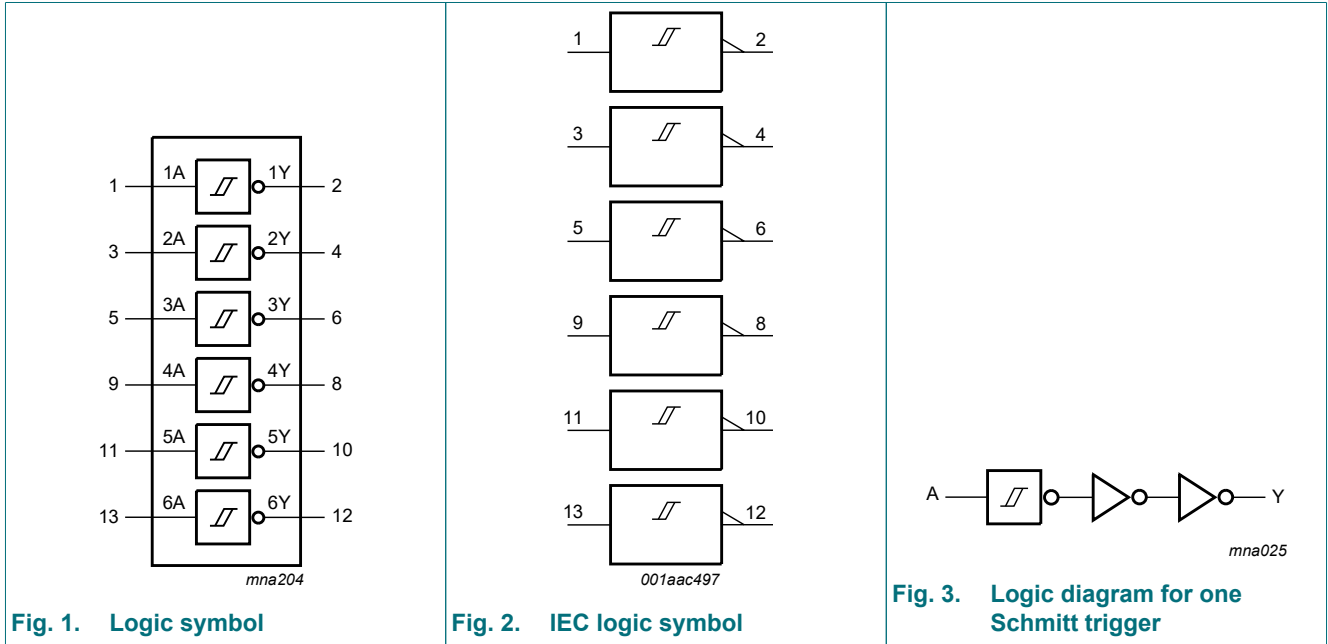
- Wave and pulse shapers for highly noisy environments
- Astable multivibrators
- Monostable multivibrators

4. Ordering information

Table 1. Ordering information

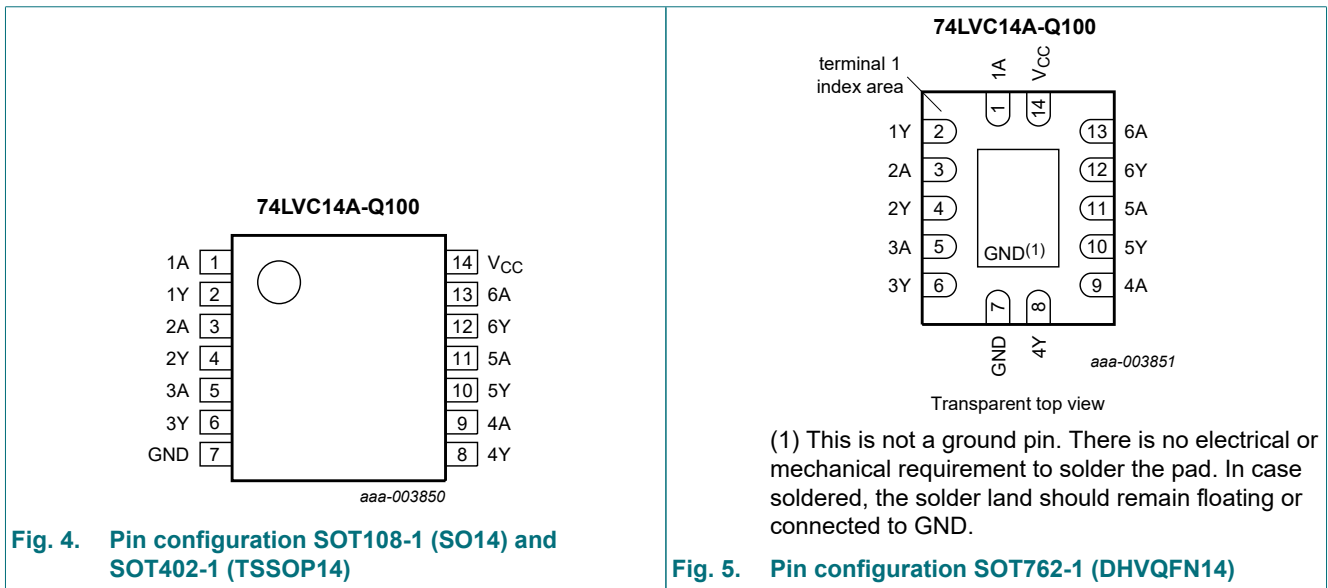
Type number	Package			Version
	Temperature range	Name	Description	
74LVC14AD-Q100	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74LVC14APW-Q100	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74LVC14ABQ-Q100	-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

5. Functional diagram



6. Pinning information

6.1. Pinning



6.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1A, 2A, 3A, 4A, 5A, 6A	1, 3, 5, 9, 11, 13	data input
1Y, 2Y, 3Y, 4Y, 5Y, 6Y	2, 4, 6, 8, 10, 12	data output
GND	7	ground (0 V)
V _{CC}	14	supply voltage

7. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level

Input nA	Output nY
L	H
H	L

8. 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	+6.5	V
V _I	input voltage	[1]	-0.5	+6.5	V
V _O	output voltage	[2]	-0.5	V _{CC} + 0.5	V
I _{IK}	input clamping current	V _I < 0 V	-50	-	mA
I _{OK}	output clamping current	V _O > V _{CC} or V _O < 0 V	-	±50	mA
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.

9. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{CC}	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	V
V _I	input voltage		0	-	5.5	V
V _O	output voltage		0	-	V _{CC}	V
T _{amb}	ambient temperature		-40	-	+125	°C

10. 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 _{OH}	HIGH-level output voltage	V _I = V _{T+} or V _{T-}						
		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 voltage output	V _I = V _{T+} or V _{T-}						
		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.

11. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 7.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t _{pd}	propagation delay	nA to nY; see Fig. 6 [2]						
		V _{CC} = 1.2 V	-	16	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	1.0	6.1	12.7	1.0	14.7	ns
		V _{CC} = 2.3 V to 2.7 V	1.5	3.5	7.8	1.5	10.0	ns
		V _{CC} = 2.7 V	1.5	3.6	7.5	1.5	9.5	ns
		V _{CC} = 3.0 V to 3.6 V	1.0	3.2	6.4	1.0	8.0	ns
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 buffer; V _I = GND to V _{CC} [4]						
		V _{CC} = 1.65 V to 1.95 V	-	9.0	-	-	-	pF
		V _{CC} = 2.3 V to 2.7 V	-	12.5	-	-	-	pF
		V _{CC} = 3.0 V to 3.6 V	-	15.6	-	-	-	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).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

f_i = input frequency in MHz; f_o = output frequency in MHz

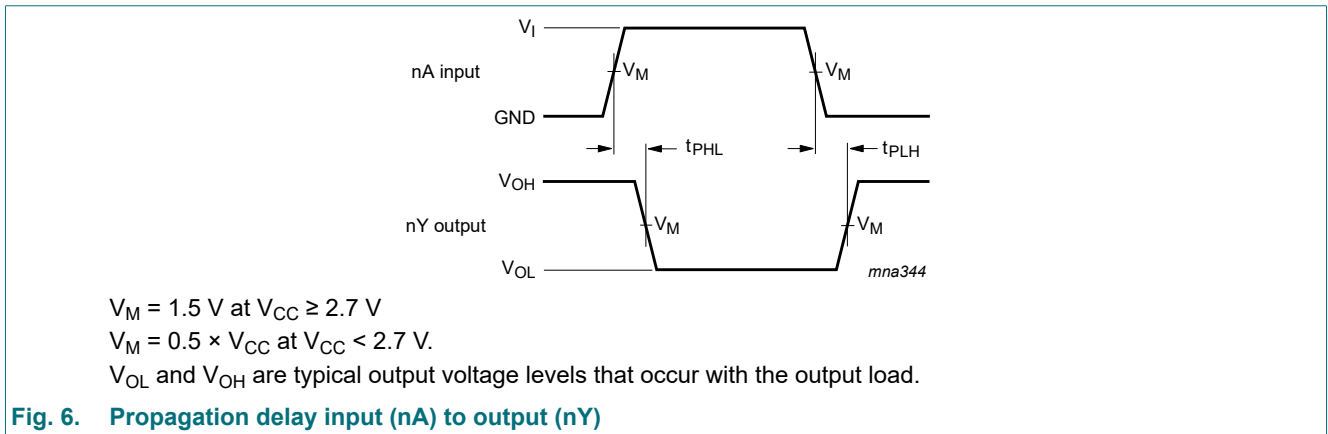
C_L = output load capacitance in pF

V_{CC} = supply voltage in Volts

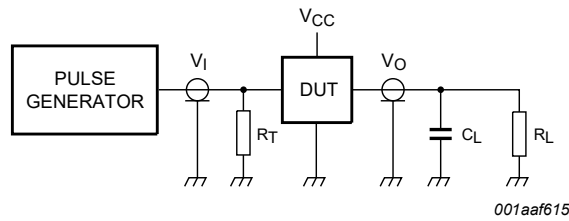
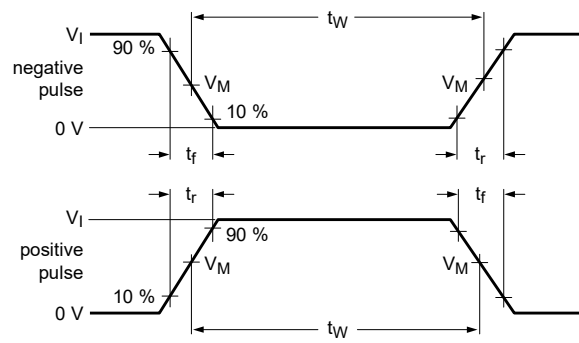
N = number of inputs switching

Σ(C_L × V_{CC}² × f_o) = sum of the outputs.

11.1. Waveforms and test circuit



Hex inverting Schmitt trigger with 5 V tolerant input



Test data is given in [Table 8](#). 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. 7. Test circuit for measuring switching times

Table 8. Test data

Supply voltage	Input		Load	
	V_I	t_r, t_f	C_L	R_L
1.2 V	V_{CC}	≤ 2 ns	30 pF	1 k Ω
1.65 V to 1.95 V	V_{CC}	≤ 2 ns	30 pF	1 k Ω
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

12. Transfer characteristics

Table 9. Transfer characteristics

Voltages are referenced to GND (ground = 0 V); see Fig. 8.

Symbol	Parameter	Conditions	T _{amb} = -40 °C to +85 °C		T _{amb} = -40 °C to +125 °C		Unit
			Min	Max	Min	Max	
V _{T+}	positive-going threshold voltage	V _{CC} = 1.2 V	0.2	1.0	0.2	1.0	V
		V _{CC} = 1.65 V	0.4	1.3	0.4	1.3	V
		V _{CC} = 1.95 V	0.6	1.5	0.6	1.5	V
		V _{CC} = 2.3 V	0.8	1.7	0.8	1.7	V
		V _{CC} = 2.5 V	0.9	1.7	0.9	1.7	V
		V _{CC} = 2.7 V	1.1	2	1.1	2	V
		V _{CC} = 3 V	1.2	2	1.2	2	V
		V _{CC} = 3.6 V	1.2	2	1.2	2	V
V _{T-}	negative-going threshold voltage	V _{CC} = 1.2 V	0.12	0.75	0.12	0.75	V
		V _{CC} = 1.65 V	0.15	0.85	0.15	0.85	V
		V _{CC} = 1.95 V	0.25	0.95	0.25	0.95	V
		V _{CC} = 2.3 V	0.4	1.1	0.4	1.1	V
		V _{CC} = 2.5 V	0.4	1.2	0.4	1.2	V
		V _{CC} = 2.7 V	0.8	1.4	0.8	1.4	V
		V _{CC} = 3 V	0.8	1.5	0.8	1.5	V
		V _{CC} = 3.6 V	0.8	1.5	0.8	1.5	V
V _H	hysteresis voltage (V _{T+} - V _{T-})	V _{CC} = 1.2 V	0.1	1.0	0.1	1.0	V
		V _{CC} = 1.65 V	0.2	1.15	0.2	1.15	V
		V _{CC} = 1.95 V	0.2	1.25	0.2	1.25	V
		V _{CC} = 2.3 V	0.3	1.3	0.3	1.3	V
		V _{CC} = 2.5 V	0.3	1.3	0.3	1.3	V
		V _{CC} = 2.7 V	0.3	1.1	0.3	1.1	V
		V _{CC} = 3 V	0.3	1.2	0.3	1.2	V
		V _{CC} = 3.6 V [1]	0.3	1.2	0.3	1.2	V

[1] Typical transfer characteristic is displayed in Fig. 9.

12.1. Waveforms transfer characteristics

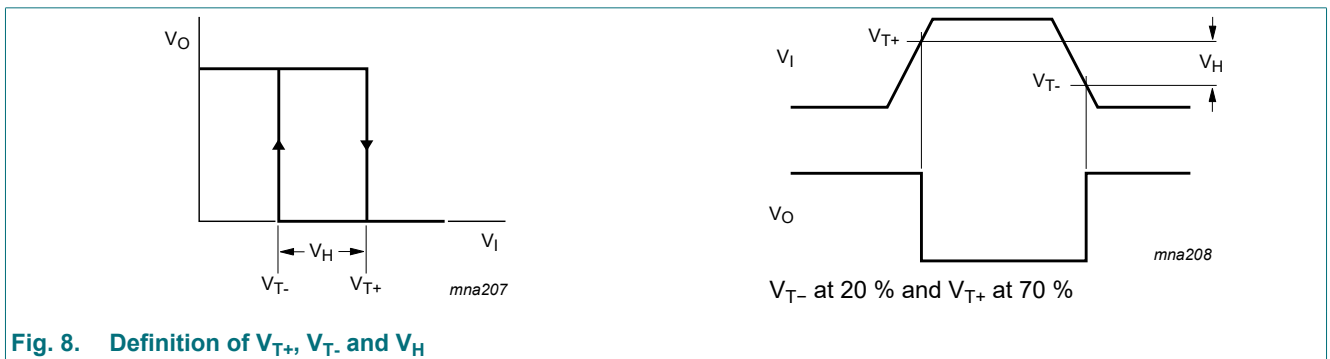
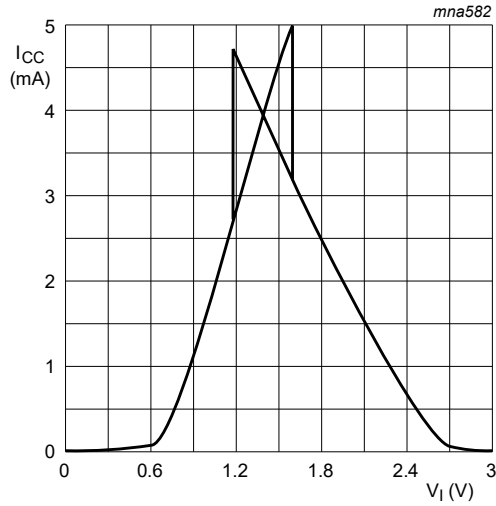


Fig. 8. Definition of V_{T+}, V_{T-} and V_H

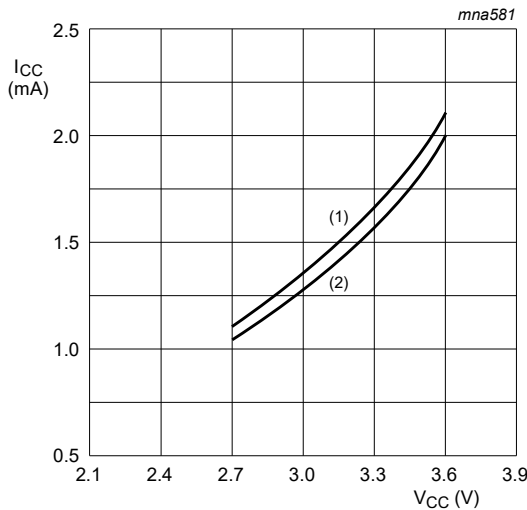
Hex inverting Schmitt trigger with 5 V tolerant input



V_{CC} = 3.3 V.

Fig. 9. Typical transfer characteristic

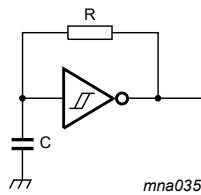
13. Application information



- (1) Positive-going edge.
- (2) Negative going-edge.

Linear change of V_I between 0.8 V to 2.0 V.
 All values given are typical unless otherwise specified.

Fig. 10. Average supply current as a function of supply voltage



$$f = \frac{1}{T} \approx \frac{1}{0.8 \times RC} \text{ at } V_{CC} = 3.0 \text{ V}$$

Fig. 11. Relaxation oscillator

14. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



Fig. 12. Package outline SOT108-1 (SO14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



Fig. 13. 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



Fig. 14. Package outline SOT762-1 (DHVQFN14)

15. Abbreviations

Table 10. Abbreviations

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

16. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC14A_Q100 v.3	20200724	Product data sheet	-	74LVC14A_Q100 v.2
Modifications:	<ul style="list-style-type: none"> 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 4: Derating values for P_{tot} total power dissipation updated. 			
74LVC14A_Q100 v.2	20160610	Product data sheet	-	74LVC14A_Q100 v.1
Modifications:	<ul style="list-style-type: none"> Table 4: table note removed (errata). 			
74LVC14A_Q100 v.1	20120807	Product data sheet	-	-

Hex inverting Schmitt trigger with 5 V tolerant input

17. 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".
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