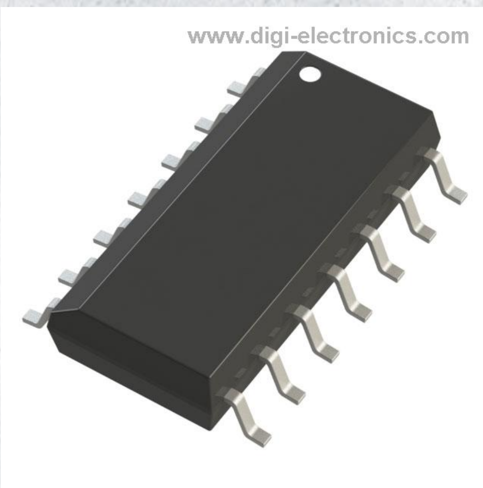
74HCT14D-Q100,118 Datasheet



https://www.DiGi-Electronics.com

DiGi Electronics Part Number	74HCT14D-Q100,118-DG
Manufacturer	Nexperia USA Inc.
Manufacturer Product Number	74HCT14D-Q100,118
Description	IC INVERT SCHMITT 6CH 1-INP 14SO
Detailed Description	Inverter IC 6 Channel Schmitt Trigger 14-SO

Tel: +00 852-30501935

RFQ Email: Info@DiGi-Electronics.com

Purchase and inquiry

Manufacturer Product Number:	Manufacturer:
74HCT14D-Q100,118	Nexperia USA Inc.
Series:	Product Status:
74HCT	Active
Logic Type:	Number of Circuits:
Inverter	6
Number of Inputs:	Features:
1	Schmitt Trigger
Voltage - Supply:	Current - Quiescent (Max):
4.5V ~ 5.5V	2 µA
Current - Output High, Low:	Input Logic Level - Low:
4mA, 4mA	0.5V ~ 0.6V
Input Logic Level - High:	Max Propagation Delay @ V, Max CL:
1.9V ~ 2.1V	34ns @ 4.5V, 50pF
Operating Temperature:	Grade:
-40°C ~ 125°C	Automotive
Qualification:	Mounting Type:
AEC-Q100	Surface Mount
Supplier Device Package:	Package / Case:
14-SO	14-SOIC (0.154", 3.90mm Width)
Base Product Number:	
74HCT14	

Environmental & Export classification

RoHS Status:	Moisture Sensitivity Level (MSL):
ROHS3 Compliant	1 (Unlimited)
REACH Status:	ECCN:
REACH Unaffected	EAR99
HTSUS:	
8542.39.0001	

74HC14-Q100; 74HCT14-Q100

Hex inverting Schmitt trigger

Rev. 8 — 29 February 2024 Product data sheet

1. General description

The 74HC14-Q100; 74HCT14-Q100 is a hex inverter with Schmitt-trigger inputs. This device features reduced input threshold levels to allow interfacing to TTL logic levels. Inputs also include clamp diodes, this enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC}. Schmitt trigger inputs transform slowly changing input signals into sharply defined jitter-free output signals.

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 2.0 to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Unlimited input rise and fall times
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Complies with JEDEC standards:
  - JESD8C (2.7 V to 3.6 V)
  - JESD7A (2.0 V to 6.0 V)
- ESD protection:
  - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
  - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Multiple package options
- DHVQFN package with Side-Wettable Flanks enabling Automatic Optical Inspection (AOI) of solder joints

3. Applications

- Wave and pulse shapers
- Astable multivibrators
- Monostable multivibrators

4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC14D-Q100 74HCT14D-Q100	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HC14PW-Q100 74HCT14PW-Q100	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74HC14BQ-Q100 74HCT14BQ-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

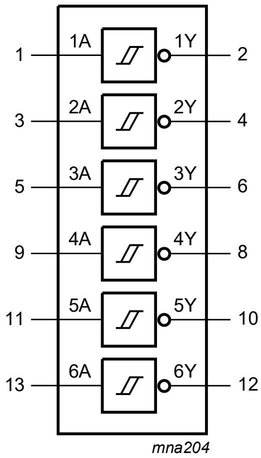


Fig. 1. Logic symbol

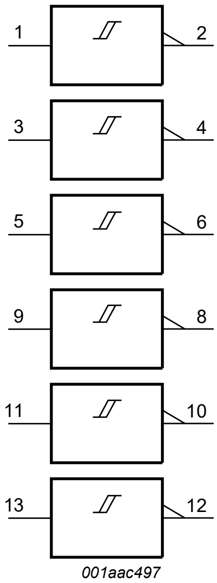


Fig. 2. IEC logic symbol

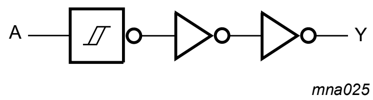
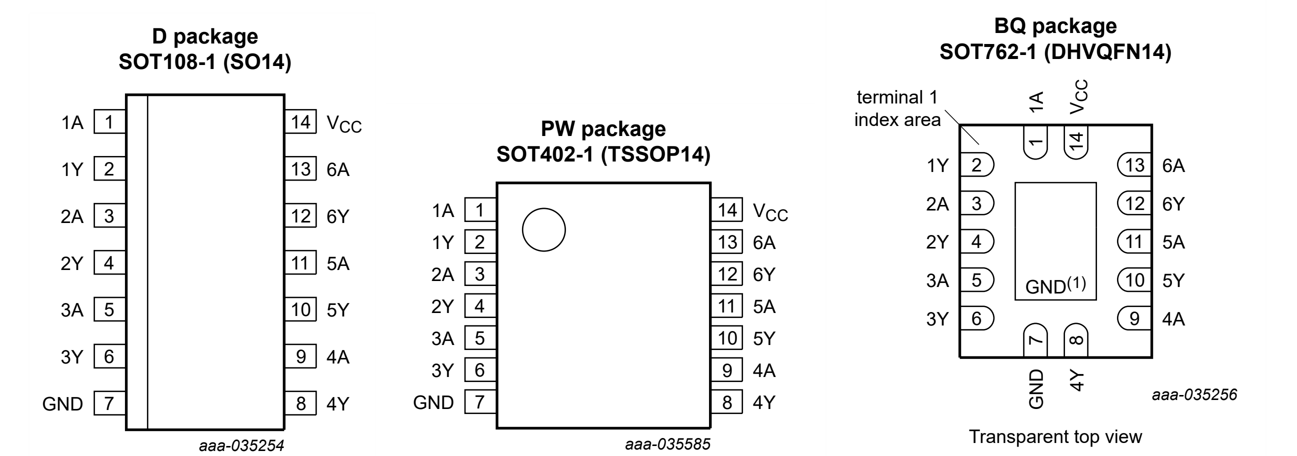


Fig. 3. Logic diagram (one Schmitt trigger)

6. Pinning information

6.1. Pinning



(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.

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	Output
nA	**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	+7	V
I_{IK}	input clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ 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	-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		[2]	-	500	mW

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

[2] 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

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC14-Q100			74HCT14-Q100			Unit
			Min	Typ	Max	Min	Typ	Max	
V_{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V_I	input voltage		0	-	V_{CC}	0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	+25	+125	-40	+25	+125	°C

10. Static characteristics

Table 6. Static characteristics

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

Symbol	Parameter	Conditions	T_{amb} = 25 °C			T_{amb} = -40 °C to +85 °C		T_{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC14-Q100										
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}								
		I_O = -20 µA; V_{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I_O = -20 µA; V_{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I_O = -20 µA; V_{CC} = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I_O = -4.0 mA; V_{CC} = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I_O = -5.2 mA; V_{CC} = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}								
		I_O = 20 µA; V_{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 20 µA; V_{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 20 µA; V_{CC} = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 4.0 mA; V_{CC} = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I_O = 5.2 mA; V_{CC} = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I_I	input leakage current	$V_I = V_{CC}$ or GND; V_{CC} = 6.0 V	-	-	±0.1	-	±1.0	-	±1.0	µA
I_{CC}	supply current	$V_I = V_{CC}$ or GND; I_O = 0 A; V_{CC} = 6.0 V	-	-	2.0	-	20	-	40	µA
C_I	input capacitance		-	3.5	-	-	-	-	-	pF
74HCT14-Q100										
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}; V_{CC} = 4.5 V								
		I_O = -20 µA	4.4	4.5	-	4.4	-	4.4	-	V
		I_O = -4.0 mA	3.98	4.32	-	3.84	-	3.7	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}; V_{CC} = 4.5 V								
		I_O = 20 µA;	-	0	0.1	-	0.1	-	0.1	V
		I_O = 4.0 mA;	-	0.15	0.26	-	0.33	-	0.4	V
I_I	input leakage current	$V_I = V_{CC}$ or GND; V_{CC} = 5.5 V	-	-	±0.1	-	±1.0	-	±1.0	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; other pins at V_{CC} or GND; I_O = 0 A; V_{CC} = 4.5 V to 5.5 V	-	30	108	-	135	-	147	µA
C_I	input capacitance		-	3.5	-	-	-	-	-	pF

11. Dynamic characteristics

Table 7. Dynamic characteristics

GND = 0 V; C_L = 50 pF; for test circuit see Fig. 5.

Symbol	Parameter	Conditions		T_{amb} = 25 °C			T_{amb} = -40 °C to +85 °C		T_{amb} = -40 °C to +125 °C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
74HC14-Q100											
t_{pd}	propagation delay	nA to nY; see Fig. 4	[1]								
		V_{CC} = 2.0 V		-	41	125	-	155	-	190	ns
		V_{CC} = 4.5 V		-	15	25	-	31	-	38	ns
		V_{CC} = 5.0 V; C_L = 15 pF		-	12	-	-	-	-	-	ns
		V_{CC} = 6.0 V		-	12	21	-	26	-	32	ns
t_t	transition time	see Fig. 4	[2]								
		V_{CC} = 2.0 V		-	19	75	-	95	-	110	ns
		V_{CC} = 4.5 V		-	7	15	-	19	-	22	ns
		V_{CC} = 6.0 V		-	6	13	-	15	-	19	ns
C_{PD}	power dissipation capacitance	per package; V_I = GND to V_{CC}	[3]	-	7	-	-	-	-	-	pF
74HCT14-Q100											
t_{pd}	propagation delay	nA to nY; see Fig. 4	[1]								
		V_{CC} = 4.5 V		-	20	34	-	43	-	51	ns
		V_{CC} = 5.0 V; C_L = 15 pF		-	17	-	-	-	-	-	ns
t_t	transition time	V_{CC} = 4.5 V; see Fig. 4	[2]	-	7	15	-	19	-	22	ns
C_{PD}	power dissipation capacitance	per package; V_I = GND to V_{CC} - 1.5 V	[3]	-	8	-	-	-	-	-	pF

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

[2] t_t is the same as t_{THL} and t_{TLH}.

[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;

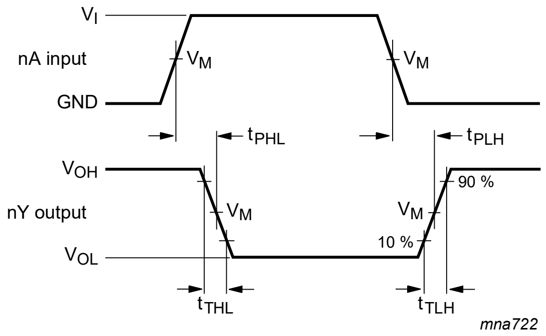
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

$\Sigma (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

11.1. Waveforms and test circuit



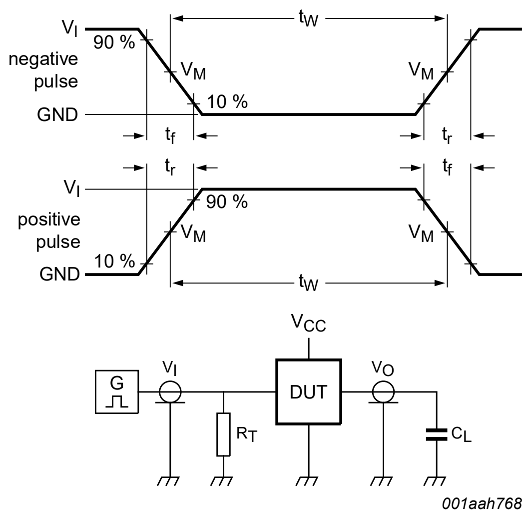
Measurement points are given in Table 8.

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

Fig. 4. Input to output propagation delays

Table 8. Measurement points

Type	Input	Output		
	V_M	V_M	V_X	V_Y
74HC14-Q100	0.5 × V_{CC}	0.5 × V_{CC}	0.1 × V_{CC}	0.9 × V_{CC}
74HCT14-Q100	1.3 V	1.3 V	0.1 × V_{CC}	0.9 × V_{CC}



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.

Fig. 5. Test circuit for measuring switching times

Table 9. Test data

Type	Input		Load	Test
	V_I	t_r, t_f	C_L	
74HC14-Q100	V_{CC}	6.0 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}
74HCT14-Q100	3.0 V	6.0 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}

12. Transfer characteristics

Table 10. Transfer characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see Fig. 6 and Fig. 7.

Symbol	Parameter	Conditions	T_{amb} = 25 °C			T_{amb} = -40 °C to +85 °C		T_{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC14-Q100										
V_{T+}	positive-going threshold voltage	V_{CC} = 2.0 V	0.7	1.18	1.5	0.7	1.5	0.7	1.5	V
		V_{CC} = 4.5 V	1.7	2.38	3.15	1.7	3.15	1.7	3.15	V
		V_{CC} = 6.0 V	2.1	3.14	4.2	2.1	4.2	2.1	4.2	V
V_{T-}	negative-going threshold voltage	V_{CC} = 2.0 V	0.3	0.52	0.9	0.3	0.9	0.3	0.9	V
		V_{CC} = 4.5 V	0.9	1.4	2.0	0.9	2.0	0.9	2.0	V
		V_{CC} = 6.0 V	1.2	1.89	2.6	1.2	2.6	1.2	2.6	V
V_H	hysteresis voltage	V_{CC} = 2.0 V	0.2	0.66	1.0	0.2	1.0	0.2	1.0	V
		V_{CC} = 4.5 V	0.4	0.98	1.4	0.4	1.4	0.4	1.4	V
		V_{CC} = 6.0 V	0.6	1.25	1.6	0.6	1.6	0.6	1.6	V
74HCT14-Q100										
V_{T+}	positive-going threshold voltage	V_{CC} = 4.5 V	1.2	1.41	1.9	1.2	1.9	1.2	1.9	V
		V_{CC} = 5.5 V	1.4	1.59	2.1	1.4	2.1	1.4	2.1	V
V_{T-}	negative-going threshold voltage	V_{CC} = 4.5 V	0.5	0.85	1.2	0.5	1.2	0.5	1.2	V
		V_{CC} = 5.5 V	0.6	0.99	1.4	0.6	1.4	0.6	1.4	V
V_H	hysteresis voltage	V_{CC} = 4.5 V	0.4	0.56	-	0.4	-	0.4	-	V
		V_{CC} = 5.5 V	0.4	0.6	-	0.4	-	0.4	-	V

12.1. Transfer characteristics waveforms

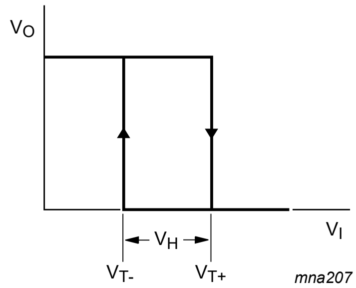


Fig. 6. Transfer characteristics

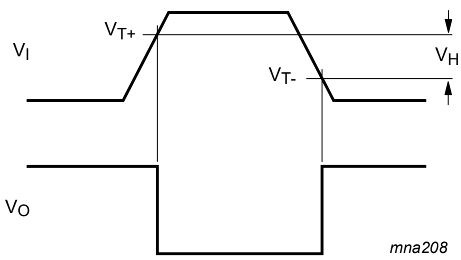
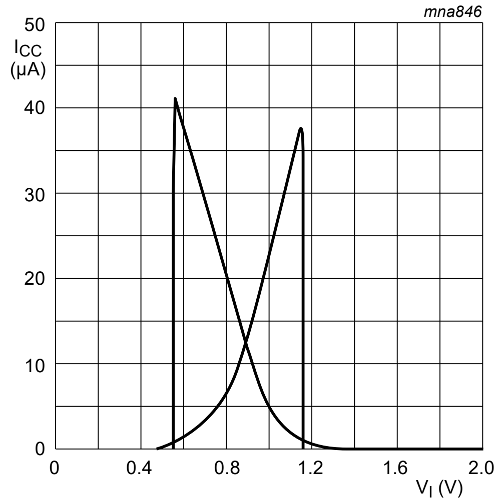
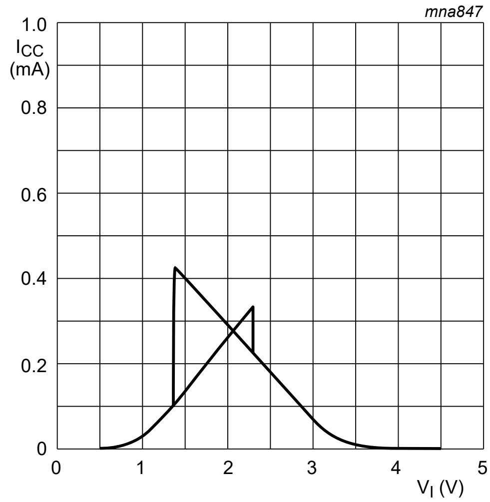


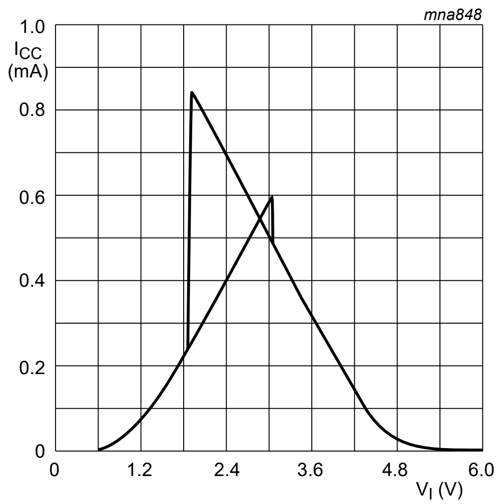
Fig. 7. Transfer characteristics definitions



a. V_{CC} = 2.0 V

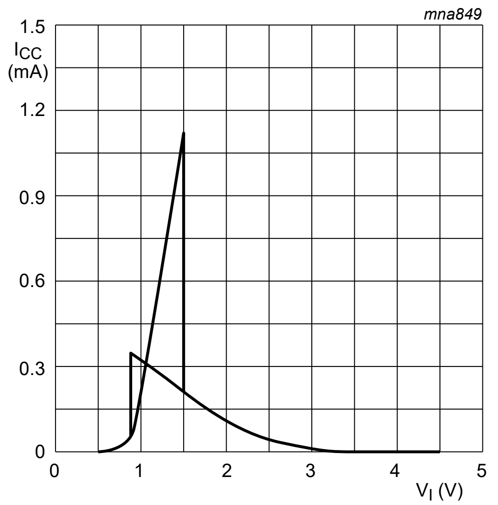


b. V_{CC} = 4.5 V

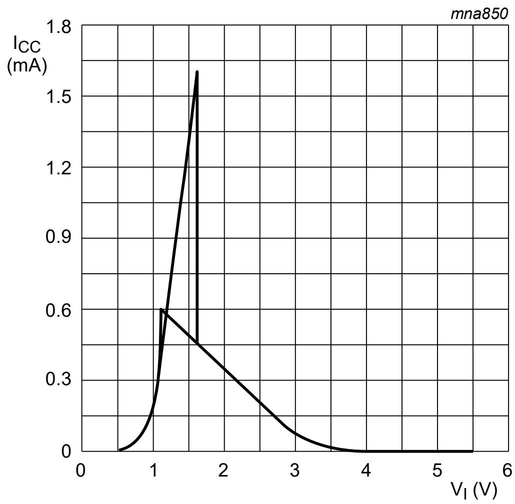


c. V_{CC} = 6.0 V

Fig. 8. Typical 74HC transfer characteristics



a. V_{CC} = 4.5 V



b. V_{CC} = 5.5 V

Fig. 9. Typical 74HCT transfer characteristics

13. Application information

The slow input rise and fall times cause additional power dissipation, this can be calculated using the following formula:

$P_{add} = f_i \times (t_r \times \Delta I_{CC(AV)} + t_f \times \Delta I_{CC(AV)}) \times V_{CC}$ where:

- P_{add} = additional power dissipation (μW);
- f_i = input frequency (MHz);
- t_r = rise time (ns); 10 % to 90 %;
- t_f = fall time (ns); 90 % to 10 %;
- $\Delta I_{CC(AV)}$ = average additional supply current (μA).

Average $\Delta I_{CC(AV)}$ differs with positive or negative input transitions, as shown in Fig. 10 and Fig. 11.

An example of a relaxation circuit using the 74HC14-Q100; 74HCT14-Q100 is shown in Fig. 12.

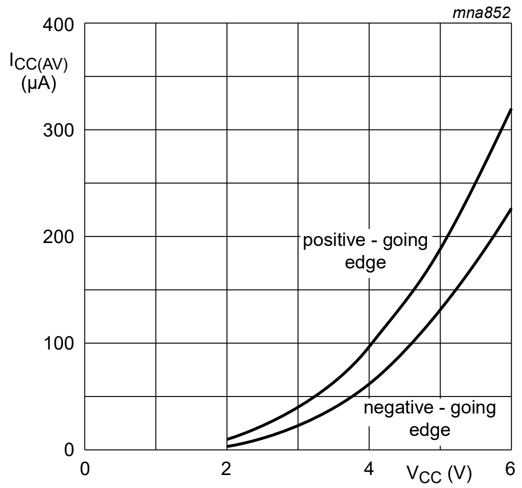


Fig. 10. Average additional supply current as a function of V_{CC} for 74HC14-Q100; linear change of V_I between $0.1V_{CC}$ to $0.9V_{CC}$.

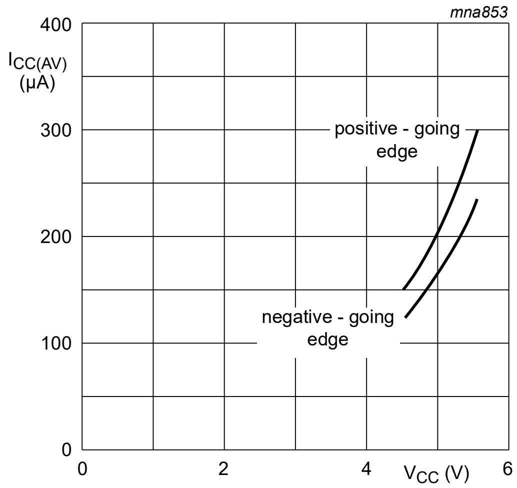
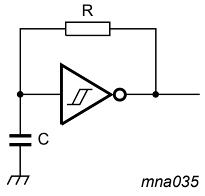


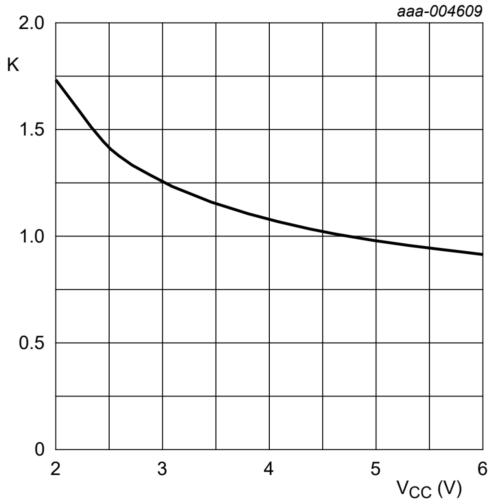
Fig. 11. Average additional supply current as a function of V_{CC} for 74HCT14-Q100; linear change of V_I between $0.1V_{CC}$ to $0.9V_{CC}$.



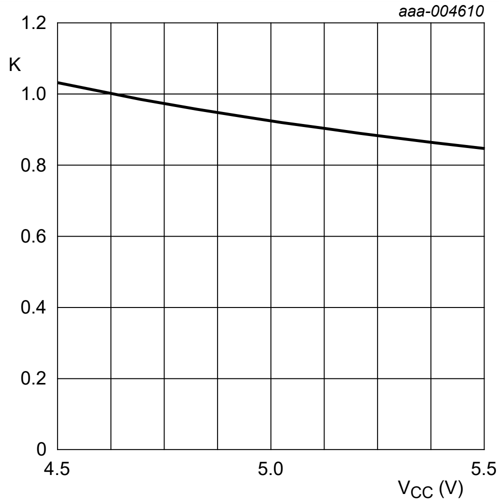
For 74HC14-Q100 and 74HCT14-Q100: $f = \frac{1}{T} \approx \frac{1}{K \times RC}$

For K-factor see Fig. 13

Fig. 12. Relaxation oscillator



K-factor for 74HC14-Q100

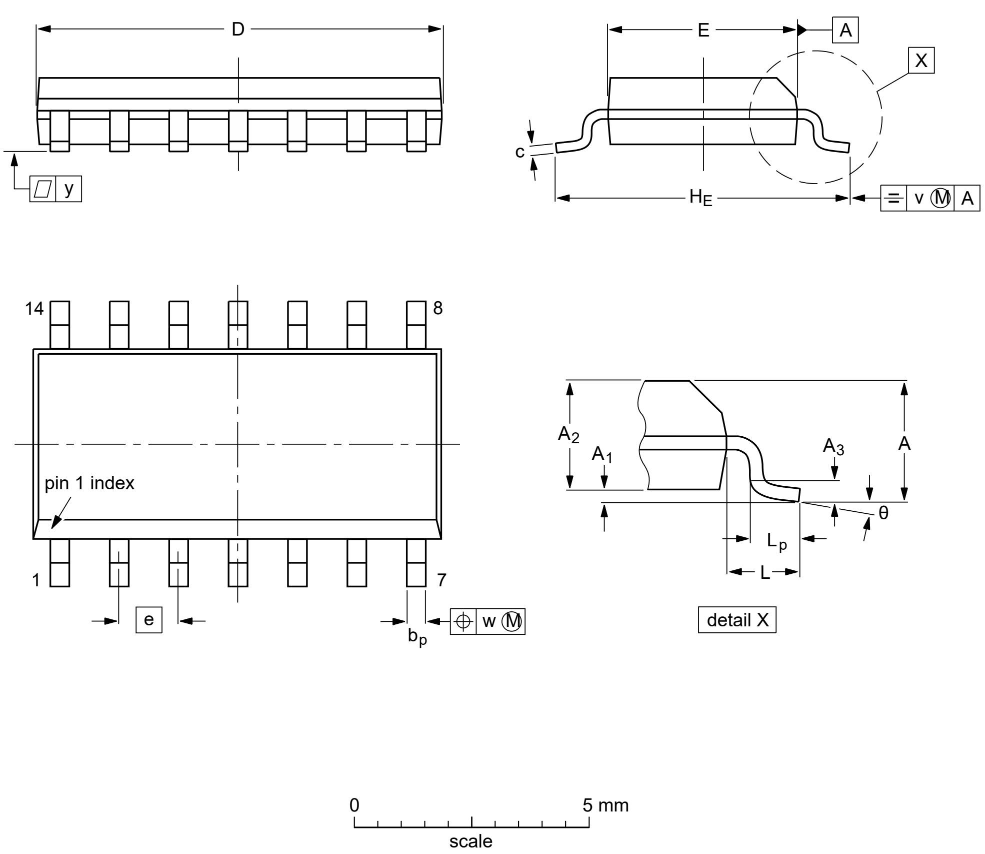


K-factor for 74HCT14-Q100

Fig. 13. Typical K-factor for relaxation oscillator

14. 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	A_1	A_2	A_3	b_p	c	D[(1)]	E[(1)]	e	H_E	L	L_p	v	w	y	θ
mm	max	1.75	0.25			0.51	0.25	8.75	4.0		6.2		1.27				8°
	nom				0.25					1.27		1.05		0.2	0.25	0.1	
	min		0.10	1.25		0.31	0.10	8.55	3.8		5.8		0.4				0°
inches	max	0.069	0.010			0.020	0.010	0.344	0.16		0.244		0.05				8°
	nom				0.01					0.05		0.041		0.008	0.01	0.004	
	min		0.004	0.049		0.012	0.004	0.337	0.15		0.228		0.016				0°

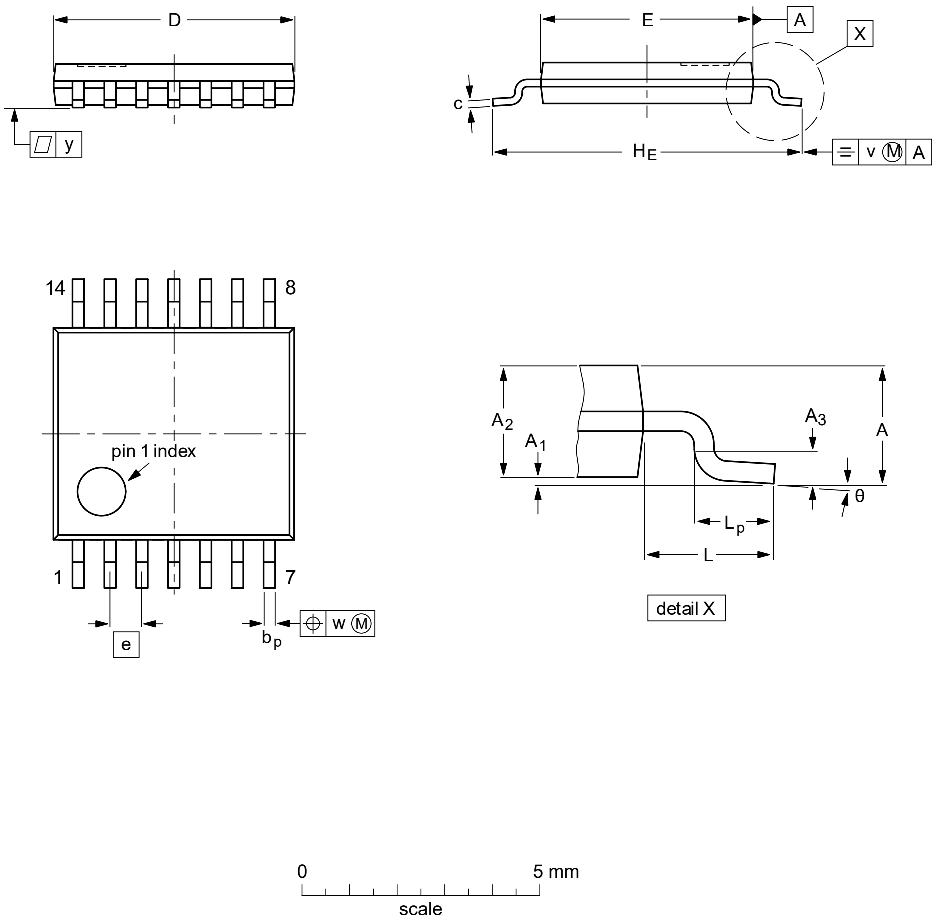
Note
1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

sot108-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT108-1		MS-012				~~03-02-19~~ 23-10-27

Fig. 14. 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	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	v	w	y	θ
mm	max	1.20	0.15	1.05		0.30	0.2	5.1	4.5		6.6		0.75				8°
	nom				0.25					0.65		1		0.2	0.1	0.1	
	min		0.05	0.80		0.19	0.09	4.9	4.3		6.2		0.45				0°

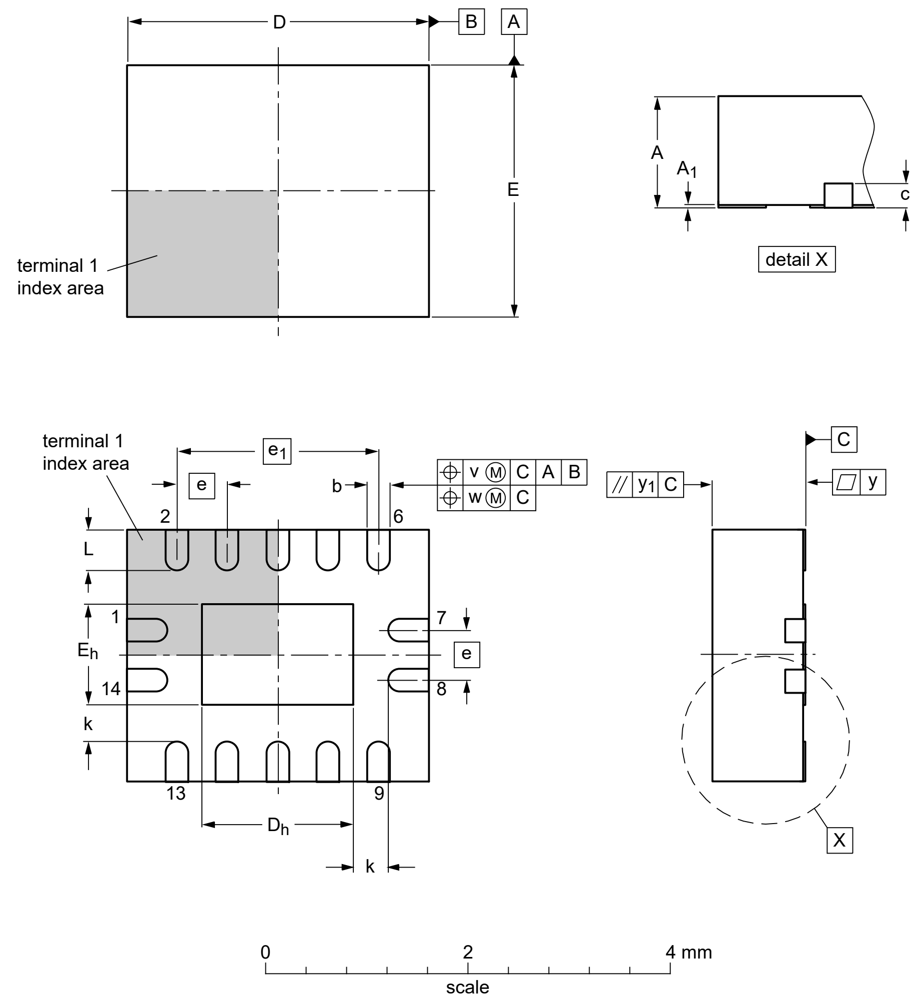
Note
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

sot402-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT402-1		MO-153				~~03-02-18~~ 23-10-27

Fig. 15. 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
mm	max	1	0.05	0.30		3.1	1.65	2.6	1.15				0.5				
	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. 16. Package outline SOT762-1 (DHVQFN14)

15. Abbreviations

Table 11. Abbreviations

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

16. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT14_Q100 v.8	20240229	Product data sheet	-	74HC_HCT14_Q100 v.7
Modifications:	• Section 2: ESD specification updated according to the latest JEDEC standard. • Fig. 14, Fig. 15: Aligned SO and TSSOP package outline drawings to JEDEC MS-012 and MO-153			
74HC_HCT14_Q100 v.7	20210813	Product data sheet	-	74HC_HCT14_Q100 v.6
Modifications:	• Section 2 updated.			
74HC_HCT14_Q100 v.6	20200522	Product data sheet	-	74HC_HCT14_Q100 v.5
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 2 updated. • Table 4: Derating values for P_{tot} total power dissipation updated.			
74HC_HCT14_Q100 v.5	20151201	Product data sheet	-	74HC_HCT14_Q100 v.4
Modifications:	• Type number 74HC14N-Q100 (SOT27-1) removed.			
74HC_HCT14_Q100 v.4	20130419	Product data sheet	-	74HC_HCT14_Q100 v.3
Modifications:	• 74HCT14N-Q100 removed.			
74HC_HCT14_Q100 v.3	20130410	Product data sheet	-	74HC_HCT14_Q100 v.2
Modifications:	• 74HC14N-Q100 and 74HCT14N-Q100 added.			
74HC_HCT14_Q100 v.2	20120810	Product data sheet	-	74HC_HCT14_Q100 v.1
Modifications:	• Fig. 13 added (typical K-factor for relaxation oscillator).			
74HC_HCT14_Q100 v.1	20120709	Product data sheet	-	-

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".
[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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