74HC3G14-Q100; 74HCT3G14-Q100

Triple inverting Schmitt trigger

Rev. 3 — 1 February 2019 **Product data sheet**

1. General description

The 74HC3G14-Q100; 74HCT3G14-Q100 is a triple inverter with Schmitt-trigger inputs. Inputs include clamp diodes that enable 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
- Complies with JEDEC standard no. 7A
- Wide supply voltage range from 2.0 V to 6.0 V
- Input levels:
  - For 74HC3G14-Q100: CMOS level
  - For 74HCT3G14-Q100: TTL level
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- Unlimited input rise and fall times
- Multiple package options
- 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)

3. Applications

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

4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC3G14DP-Q100	-40 °C to +125 °C	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm	SOT505-2
74HCT3G14DP-Q100				
74HC3G14DC-Q100	-40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1
74HCT3G14DC-Q100				

nexperia

5. Marking

Table 2. Marking

Type number	Marking code [1]
74HC3G14DP-Q100	H14
74HCT3G14DP-Q100	T14
74HC3G14DC-Q100	H14
74HCT3G14DC-Q100	T14

[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

6. Functional diagram

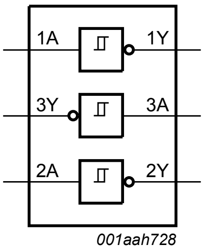


Fig. 1. Logic symbol

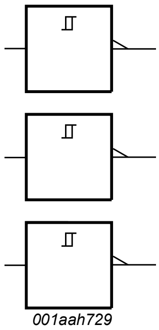


Fig. 2. IEC logic symbol

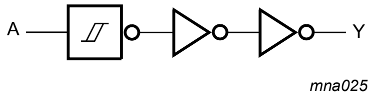


Fig. 3. Logic diagram (one Schmitt trigger)

7. Pinning information

7.1. Pinning

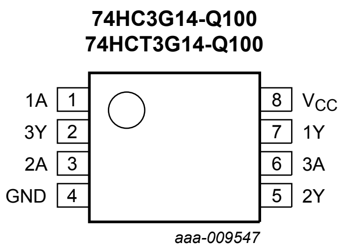


Fig. 4. Pin configuration SOT505-2 (TSSOP8) and SOT765-1 (VSSOP8)

7.2. Pin description

Table 3. Pin description

Symbol	Pin	Description
1A, 2A, 3A	1, 3, 6	data input
GND	4	ground (0 V)
1Y, 2Y, 3Y	7, 5, 2	data output
V_{CC}	8	supply voltage

8. Functional description

Table 4. Function table

H = HIGH voltage level; L = LOW voltage level.

Input	Output
nA	nY
L	H
H	L

9. 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	+7.0	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	V_O = -0.5 V to V_{CC} + 0.5 V	[1]	-	±25	mA
I_{CC}	supply current		[1]	-	+50	mA
I_{GND}	ground current		[1]	-50	-	mA
T_{stg}	storage temperature			-65	+150	°C
P_{tot}	total power dissipation		[2]	-	300	mW

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2] For TSSOP8 package: above 55 °C the value of P_{tot} derates linearly with 2.5 mW/K.
For VSSOP8 package: above 110 °C the value of P_{tot} derates linearly with 8 mW/K.

10. Recommended operating conditions

Table 6. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	74HC3G14-Q100			74HCT3G14-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

11. Static characteristics

Table 7. Static characteristics

Voltages are referenced to GND (ground = 0 V). All typical values are measured at T_{amb} = 25 °C.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC3G14-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	4.18	4.32	-	4.13	-	3.7	-	V
		I_O = -5.2 mA; V_{CC} = 6.0 V	5.68	5.81	-	5.63	-	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	per input pin; V_{CC} = 6.0 V; $V_I = V_{CC}$ or GND; I_O = 0 A	-	-	1.0	-	10	-	20	µA
C_I	input capacitance		-	2.0	-	-	-	-	-	pF
74HCT3G14-Q100										
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}								
		I_O = -20 µA; V_{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I_O = -4.0 mA; V_{CC} = 4.5 V	4.18	4.32	-	4.13	-	3.7	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}								
		I_O = 20 µA; V_{CC} = 4.5 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_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	per input pin; V_{CC} = 5.5 V; $V_I = V_{CC}$ or GND; I_O = 0 A	-	-	1.0	-	10	-	20	µA
ΔI_{CC}	additional supply current	per input; V_{CC} = 4.5 V to 5.5 V; $V_I = V_{CC}$ - 2.1 V; I_O = 0 A	-	-	300	-	375	-	410	µA
C_I	input capacitance		-	2.0	-	-	-	-	-	pF

11.1. Transfer characteristics

Table 8. Transfer characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 10.

Symbol	Parameter	Conditions	25 °C			-40 °C to +125 °C			Unit
			Min	Typ	Max	Min	Max (85 °C)	Max (125 °C)	
74HC3G14-Q100									
V_{T+}	positive-going threshold voltage	see Fig. 5, Fig. 6							
		V_{CC} = 2.0 V	1.00	1.18	1.50	1.00	1.50	1.50	V
		V_{CC} = 4.5 V	2.30	2.60	3.15	2.30	3.15	3.15	V
		V_{CC} = 6.0 V	3.00	3.46	4.20	3.00	4.20	4.20	V
V_{T-}	negative-going threshold voltage	see Fig. 5, Fig. 6							
		V_{CC} = 2.0 V	0.30	0.60	0.90	0.30	0.90	0.90	V
		V_{CC} = 4.5 V	1.13	1.47	2.00	1.13	2.00	2.00	V
		V_{CC} = 6.0 V	1.50	2.06	2.60	1.50	2.60	2.60	V
V_H	hysteresis voltage	(V_{T+} - V_{T-}); see Fig. 5, Fig. 6 and Fig. 7							
		V_{CC} = 2.0 V	0.30	0.60	1.00	0.30	1.00	1.00	V
		V_{CC} = 4.5 V	0.60	1.13	1.40	0.60	1.40	1.40	V
		V_{CC} = 6.0 V	0.80	1.40	1.70	0.80	1.70	1.70	V
74HCT3G14-Q100									
V_{T+}	positive-going threshold voltage	see Fig. 5, Fig. 6							
		V_{CC} = 4.5 V	1.20	1.58	1.90	1.20	1.90	1.90	V
		V_{CC} = 5.5 V	1.40	1.78	2.10	1.40	2.10	2.10	V
V_{T-}	negative-going threshold voltage	see Fig. 5, Fig. 6							
		V_{CC} = 4.5 V	0.50	0.87	1.20	0.50	1.20	1.20	V
		V_{CC} = 5.5 V	0.60	1.11	1.40	0.60	1.40	1.40	V
V_H	hysteresis voltage	(V_{T+} - V_{T-}); see Fig. 5, Fig. 6 and Fig. 8							
		V_{CC} = 4.5 V	0.40	0.71	-	0.40	-	-	V
		V_{CC} = 5.5 V	0.40	0.67	-	0.40	-	-	V

11.2. Transfer characteristics waveforms

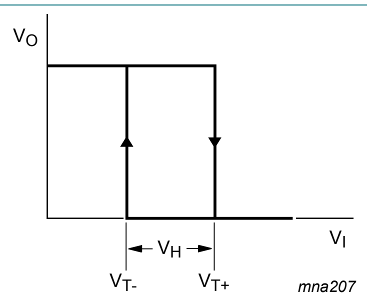


Fig. 5. Transfer characteristic

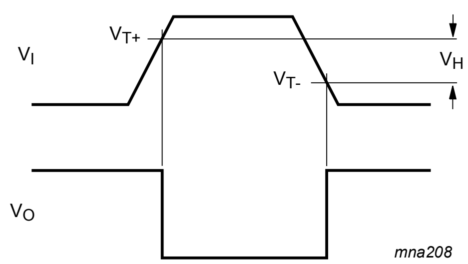
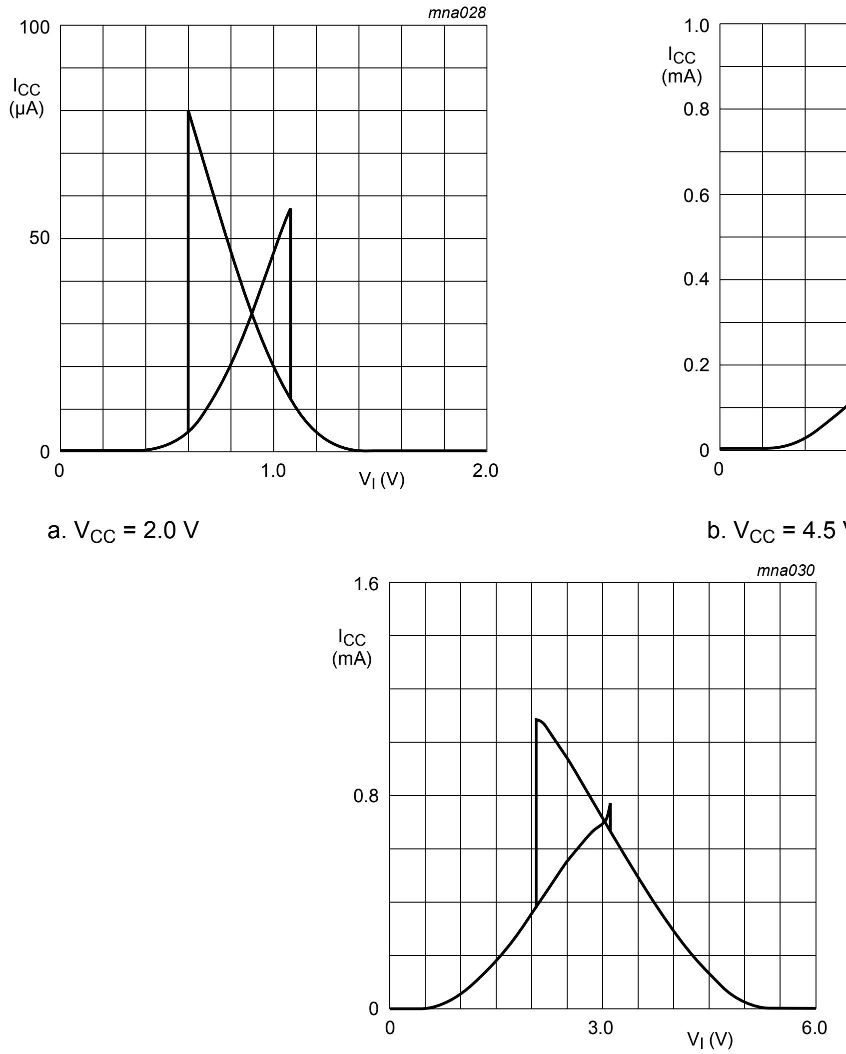


Fig. 6. Definition of V_{T+}, V_{T-} and V_H

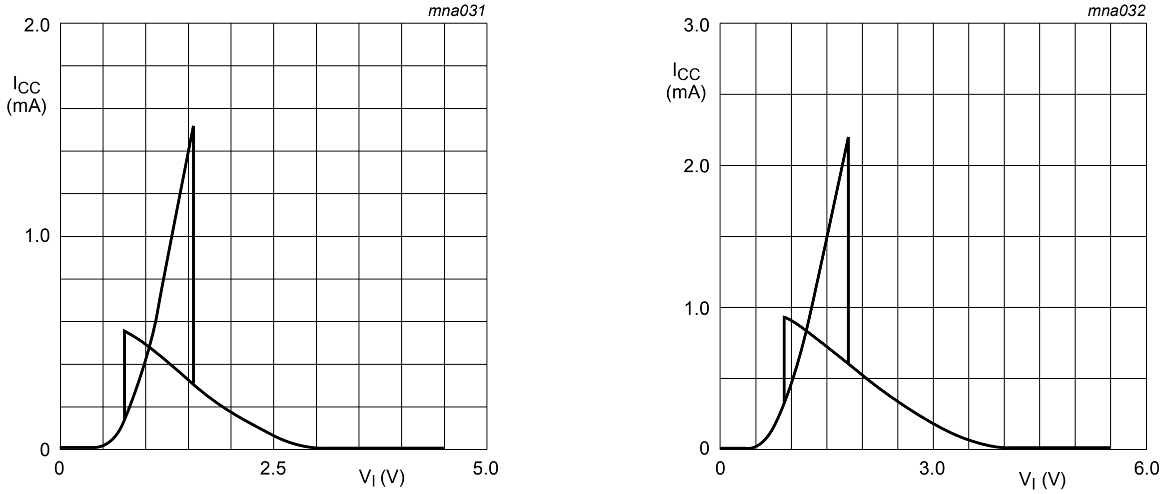


a. V_{CC} = 2.0 V

b. V_{CC} = 4.5 V

c. V_{CC} = 6.0 V

Fig. 7. Typical 74HC3G14-Q100 transfer characteristics



a. V_{CC} = 4.5 V.

b. V_{CC} = 5.5 V.

Fig. 8. Typical 74HCT3G14-Q100 transfer characteristics

12. Dynamic characteristics

Table 9. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 10.

Symbol	Parameter	Conditions		25 °C			-40 °C to +125 °C			Unit
				Min	Typ	Max	Min	Max (85 °C)	Max (125 °C)	
74HC3G14-Q100										
t_{pd}	propagation delay	nA to nY; see Fig. 9	[1]							
		V_{CC} = 2.0 V		-	53	125	-	155	190	ns
		V_{CC} = 4.5 V		-	16	25	-	31	38	ns
		V_{CC} = 6.0 V		-	13	21	-	26	32	ns
t_t	transition time	nY; see Fig. 9	[2]							
		V_{CC} = 2.0 V		-	20	75	-	95	110	ns
		V_{CC} = 4.5 V		-	7	15	-	19	22	ns
		V_{CC} = 6.0 V		-	5	13	-	16	19	ns
C_{PD}	power dissipation capacitance	V_I = GND to V_{CC}	[3]	-	10	-	-	-	-	pF
74HCT3G14-Q100										
t_{pd}	propagation delay	nA to nY; V_{CC} = 4.5 V; see Fig. 9	[1]	-	21	32	-	40	48	ns
t_t	transition time	nY; V_{CC} = 4.5 V; see Fig. 9	[2]	-	6	15	-	19	22	ns
C_{PD}	power dissipation capacitance	V_I = GND to V_{CC} - 1.5 V	[3]	-	10	-	-	-	-	pF

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

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

[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;

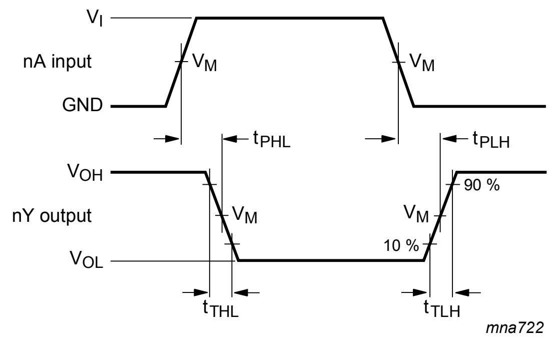
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

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

12.1. Waveforms and test circuit



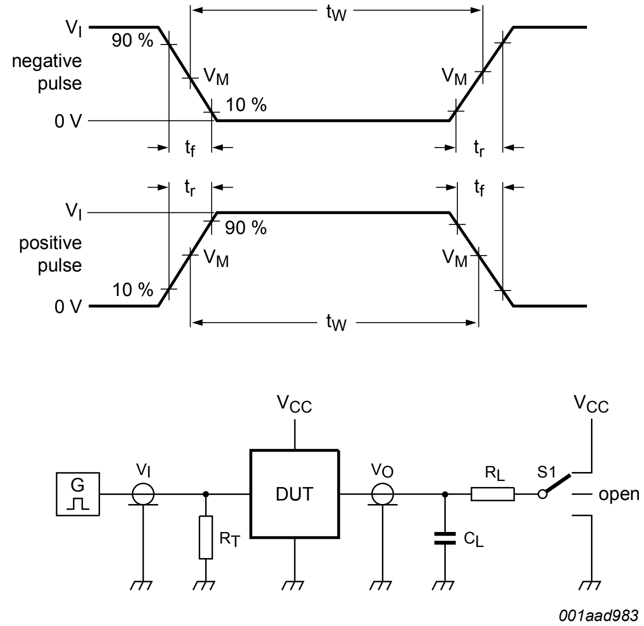
Measurement points are given in Table 10.

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

Fig. 9. The data input (nA) to output (nY) propagation delays and output transition times

Table 10. Measurement points

Type	Input	Output
	V_M	V_M
74HC3G14-Q100	$0.5V_{CC}$	$0.5V_{CC}$
74HCT3G14-Q100	1.3 V	1.3 V



Test data is given in Table 11.
Definitions for 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. 10. Test circuit for measuring switching times

Table 11. Test data

Type	Input		Load		S1 position
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}
74HC3G14-Q100	GND to V_{CC}	≤ 6 ns	50 pF	1 kΩ	open
74HCT3G14-Q100	GND to 3.0 V	≤ 6 ns	50 pF	1 kΩ	open

13. Application information

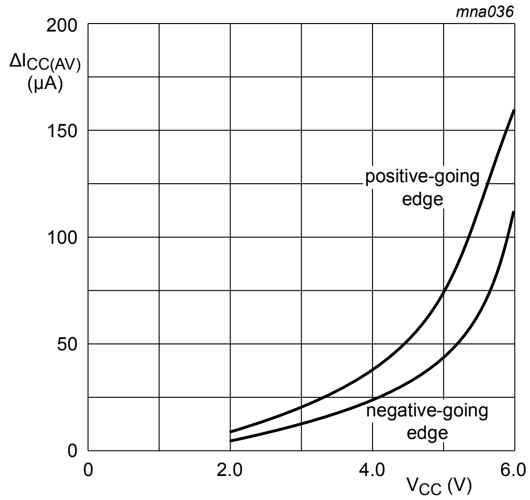
The slow input rise and fall times cause additional power dissipation, which can be calculated using the following formula:

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

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

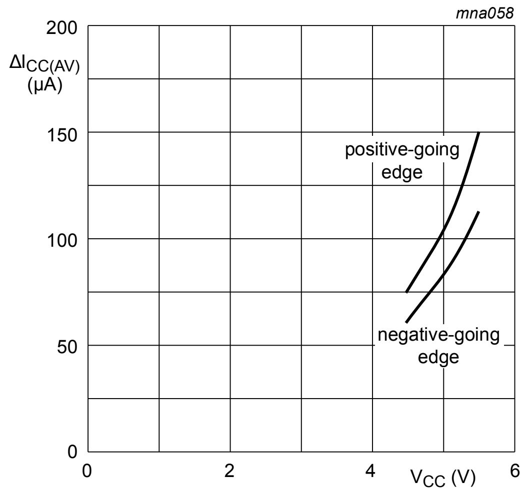
$\Delta I_{CC(AV)}$ differs with positive or negative input transitions, as shown in Fig. 11 and Fig. 12.

An example of a relaxation circuit using the 74HC3G14-Q100/74HCT3G14-Q100 is shown in Fig. 13.



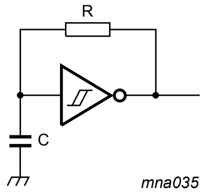
Linear change of V_I between $0.1V_{CC}$ to $0.9V_{CC}$.

Fig. 11. $\Delta I_{CC(AV)}$ as a function of V_{CC} for 74HC3G14-Q100



Linear change of V_I between $0.1V_{CC}$ to $0.9V_{CC}$.

Fig. 12. $\Delta I_{CC(AV)}$ as a function of V_{CC} for 74HCT3G14-Q100

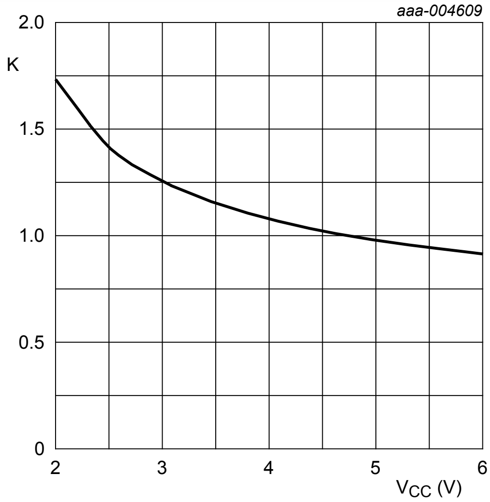


For 74HC3G14-Q100: $f = \frac{1}{T} \approx \frac{1}{0.8 \times RC}$

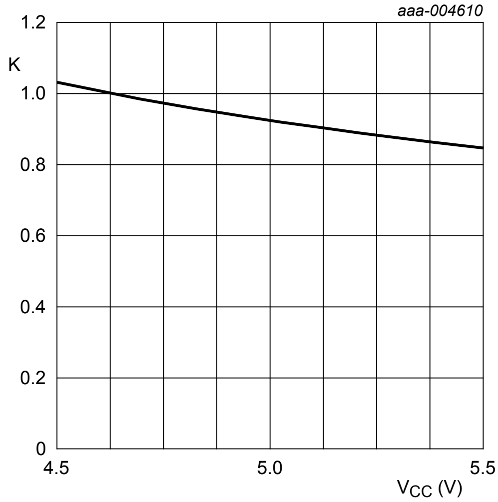
For 74HCT3G14-Q100: $f = \frac{1}{T} \approx \frac{1}{0.67 \times RC}$

For K-factor, see Fig. 14

Fig. 13. Relaxation oscillator



a. K-factor for 74HC3G14-Q100

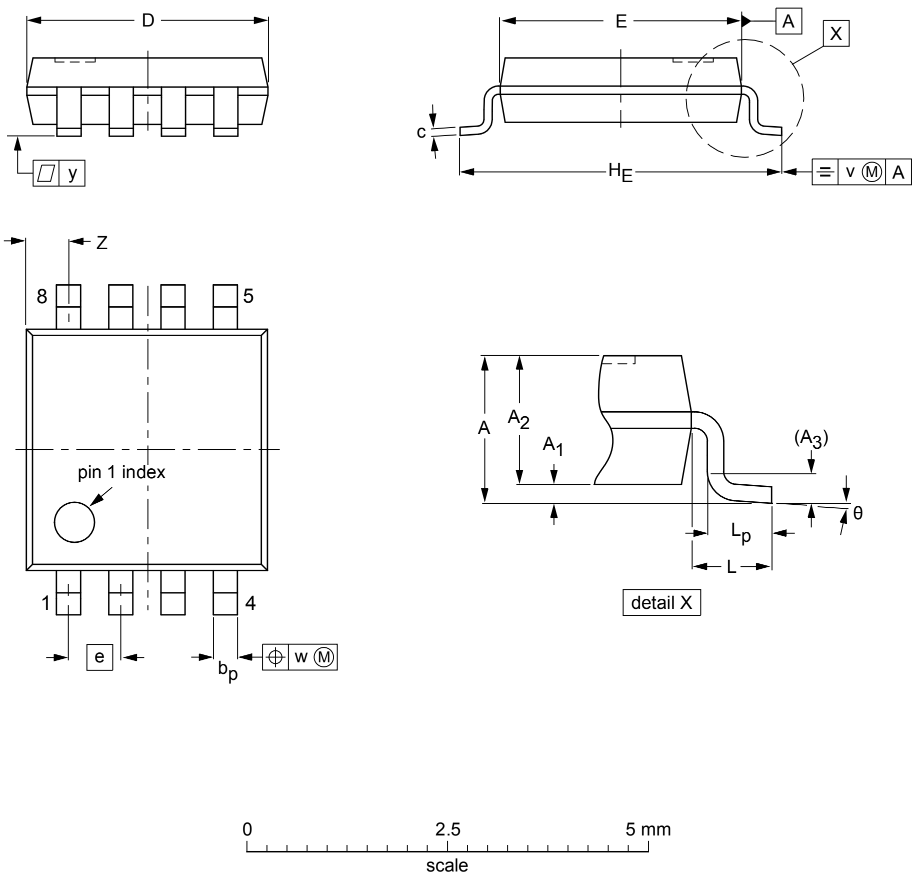


b. K-factor for 74HCT3G14-Q100

Fig. 14. Typical K-factor for relaxation oscillator

14. Package outline

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm **SOT505-2**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	v	w	y	Z(1)	θ
mm	1.1	0.15 0.00	0.95 0.75	0.25	0.38 0.22	0.18 0.08	3.1 2.9	3.1 2.9	0.65	4.1 3.9	0.5	0.47 0.33	0.2	0.13	0.1	0.70 0.35	8° 0°

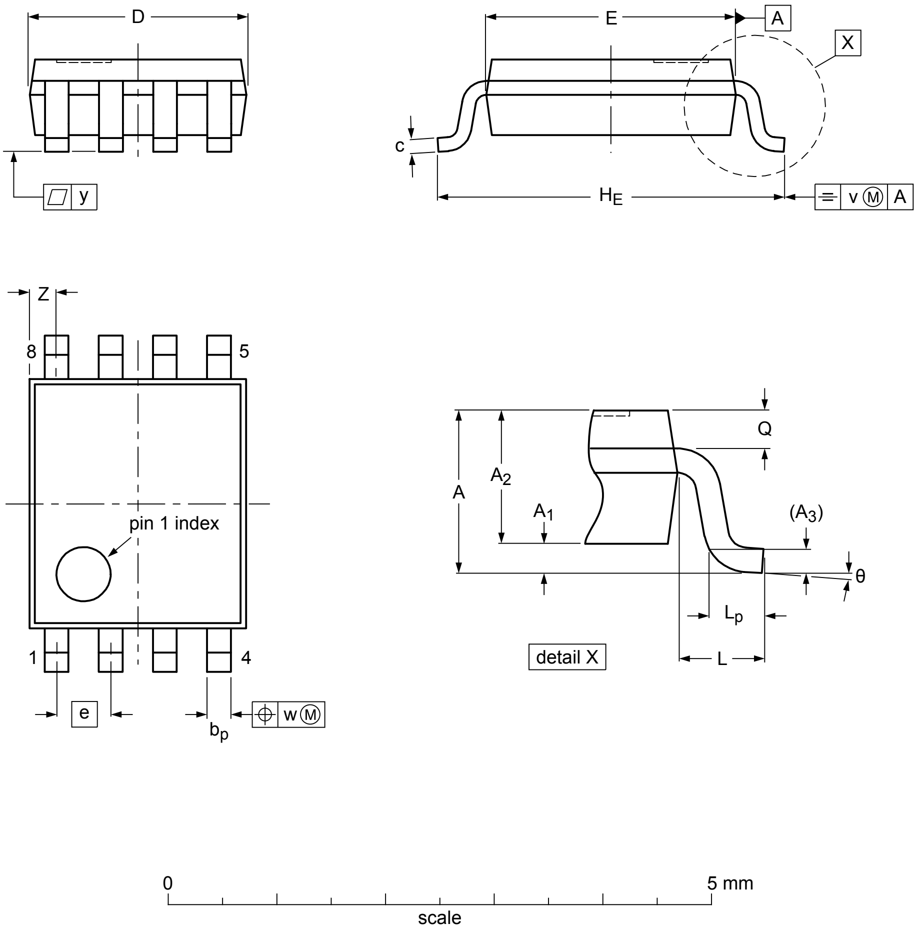
Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT505-2		- - -				02-01-16

Fig. 15. Package outline SOT505-2 (TSSOP8)

VSSOP8: plastic very thin shrink small outline package; 8 leads; body width 2.3 mm **SOT765-1**



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
	max		0.15	0.85		0.27	0.23	2.1	2.4		3.2		0.40	0.21				0.4	8°
mm	nom	1			0.12					0.5		0.4			0.2	0.08	0.1		
	min		0.00	0.60		0.17	0.08	1.9	2.2		3.0		0.15	0.19				0.1	0°

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

sot765-1_po

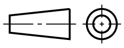
Outline version	References IEC	References JEDEC	References JEITA		European projection	Issue date
SOT765-1		MO-187				~~07-06-02~~ 16-05-31

Fig. 16. Package outline SOT765-1 (VSSOP8)

15. Abbreviations

Table 12. 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 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT3G14_Q100 v.3	20190201	Product data sheet	-	74HC_HCT3G14_Q100 v.2
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. • Package outline drawing SOT765-1 (VSSOP8) updated.			
74HC_HCT3G14_Q100 v.2	20131209	Product data sheet	-	74HC_HCT3G14_Q100 v.1
Modifications:	• Fig. 14 added (typical K-factor for relaxation oscillator).			
74HC_HCT3G14_Q100 v.1	20131115	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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Contents

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