74HC2G14; 74HCT2G14

Dual inverting Schmitt trigger

Rev. 2 — 14 March 2014 | Product data sheet

1. General description

The 74HC2G14; 74HCT2G14 is a dual inverter with Schmitt-trigger inputs. Inputs 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.

2. Features and benefits

- Wide supply voltage range from 2.0 V to 6.0 V
- Complies with JEDEC standard no. 7A
- Input levels:
  - For 74HC2G14: CMOS level
  - For 74HCT2G14: TTL level
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- Unlimited input rise and fall times
- Multiple package options
- ESD protection:
  - HBM JESD22-A114E exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Specified from –40 °C to +85 °C and –40 °C to +125 °C

3. Applications

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

nexperia

4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC2G14GW	–40 °C to +125 °C	SC-88	plastic surface-mounted package; 6 leads	SOT363
74HC2G14GV	–40 °C to +125 °C	SC-74	plastic surface-mounted package (TSOP6); 6 leads	SOT457
74HCT2G14GW	–40 °C to +125 °C	SC-88	plastic surface-mounted package; 6 leads	SOT363
74HCT2G14GV	–40 °C to +125 °C	SC-74	plastic surface-mounted package (TSOP6); 6 leads	SOT457

5. Marking

Table 2. Marking

Type number	Marking code[1]
74HC2G14GW	HK
74HC2G14GV	H14
74HCT2G14GW	TK
74HCT2G14GV	T14

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

6. Functional diagram

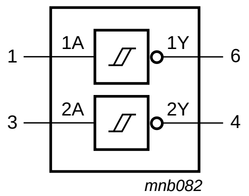


Fig 1. Logic symbol

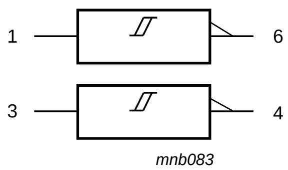


Fig 2. IEC logic symbol

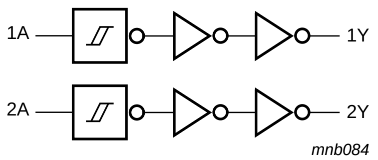


Fig 3. Logic diagram

7. Pinning information

7.1 Pinning

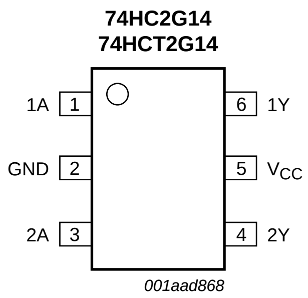


Fig 4. Pin configuration

7.2 Pin description

Table 3. Pin description

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

8. Functional description

Table 4. Function table[1]

Input	Output
nA	**nY**
L	H
H	L

[1] H = HIGH voltage level;
L = LOW voltage level.

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]	-	250	mW

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

[2] For SC-88 and SC-74 packages: above 87.5 °C the value of P_{tot} derates linearly with 4.0 mW/K.

10. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Type 74HC2G14						
V_{CC}	supply voltage		2.0	5.0	6.0	V
V_I	input voltage		0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		–40	+25	+125	°C
Type 74HCT2G14						
V_{CC}	supply voltage		4.5	5.0	5.5	V
V_I	input voltage		0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		–40	+25	+125	°C

11. Static characteristics

Table 7. Static characteristics for 74HC2G14

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = 25 °C						
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	-	V
		I_O = –20 μA; V_{CC} = 4.5 V	4.4	4.5	-	V
		I_O = –20 μA; V_{CC} = 6.0 V	5.9	6.0	-	V
		I_O = –4.0 mA; V_{CC} = 4.5 V	4.18	4.32	-	V
		I_O = –5.2 mA; V_{CC} = 6.0 V	5.68	5.81	-	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	V
		I_O = 20 μA; V_{CC} = 4.5 V	-	0	0.1	V
		I_O = 20 μA; V_{CC} = 6.0 V	-	0	0.1	V
		I_O = 4.0 mA; V_{CC} = 4.5 V	-	0.15	0.26	V
		I_O = 5.2 mA; V_{CC} = 6.0 V	-	0.16	0.26	V
I_I	input leakage current	V_I = GND or V_{CC}; V_{CC} = 6.0 V	-	-	±0.1	μA
I_{CC}	supply current	V_I = GND or V_{CC}; I_O = 0 μA; V_{CC} = 6.0 V	-	-	1.0	μA
C_I	input capacitance		-	2.0	-	pF
T_{amb} = –40 °C to +85 °C						
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = –20 μA; V_{CC} = 2.0 V	1.9	-	-	V
		I_O = –20 μA; V_{CC} = 4.5 V	4.4	-	-	V
		I_O = –20 μA; V_{CC} = 6.0 V	5.9	-	-	V
		I_O = –4.0 mA; V_{CC} = 4.5 V	4.13	-	-	V
		I_O = –5.2 mA; V_{CC} = 6.0 V;	5.63	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = 20 μA; V_{CC} = 2.0 V	-	-	0.1	V
		I_O = 20 μA; V_{CC} = 4.5 V	-	-	0.1	V
		I_O = 20 μA; V_{CC} = 6.0 V	-	-	0.1	V
		I_O = 4.0 mA; V_{CC} = 4.5 V	-	-	0.33	V
		I_O = 5.2 mA; V_{CC} = 6.0 V	-	-	0.33	V
I_I	input leakage current	V_I = GND or V_{CC}; V_{CC} = 6.0 V	-	-	±1.0	μA
I_{CC}	supply current	V_I = GND or V_{CC}; I_O = 0 μA; V_{CC} = 6.0 V	-	-	10.0	μA

Table 7. Static characteristics for 74HC2G14 *...continued*

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = –40 °C to +125 °C						
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = –20 μA; V_{CC} = 2.0 V	1.9	-	-	V
		I_O = –20 μA; V_{CC} = 4.5 V	4.4	-	-	V
		I_O = –20 μA; V_{CC} = 6.0 V	5.9	-	-	V
		I_O = –4.0 mA; V_{CC} = 4.5 V	3.7	-	-	V
		I_O = –5.2 mA; V_{CC} = 6.0 V;	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	-	-	0.1	V
		I_O = 20 μA; V_{CC} = 4.5 V	-	-	0.1	V
		I_O = 20 μA; V_{CC} = 6.0 V	-	-	0.1	V
		I_O = 4.0 mA; V_{CC} = 4.5 V	-	-	0.4	V
		I_O = 5.2 mA; V_{CC} = 6.0 V	-	-	0.4	V
I_I	input leakage current	V_I = GND or V_{CC}; V_{CC} = 6.0 V	-	-	±1.0	μA
I_{CC}	supply current	V_I = GND or V_{CC}; I_O = 0 μA; V_{CC} = 6.0 V	-	-	20.0	μA

Table 8. Static characteristics for 74HCT2G14

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = 25 °C						
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	-	V
		I_O = –4.0 mA; V_{CC} = 4.5 V	4.18	4.32	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = 20 μA; V_{CC} = 4.5 V	-	0	0.1	V
		I_O = 4.0 mA; V_{CC} = 4.5 V	-	0.15	0.26	V
I_I	input leakage current	V_I = GND or V_{CC}; V_{CC} = 5.5 V	-	-	±0.1	μA
I_{CC}	supply current	V_I = GND or V_{CC}; I_O = 0 μA; V_{CC} = 5.5 V	-	-	1.0	μA
ΔI_{CC}	additional supply current	$V_I = V_{CC} - 2.1$ V; V_{CC} = 4.5 V to 5.5 V; I_O = 0 μA	-	-	300	μA
C_I	input capacitance		-	2.0	-	pF

Table 8. Static characteristics for 74HCT2G14 *...continued*

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = –40 °C to +85 °C						
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = –20 μA; V_{CC} = 4.5 V	4.4	-	-	V
		I_O = –4.0 mA; V_{CC} = 4.5 V	4.13	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = 20 μA; V_{CC} = 4.5 V	-	-	0.1	V
		I_O = 4.0 mA; V_{CC} = 4.5 V	-	-	0.33	V
I_I	input leakage current	V_I = GND or V_{CC}; V_{CC} = 5.5 V	-	-	±1.0	μA
I_{CC}	supply current	V_I = GND or V_{CC}; I_O = 0 μA; V_{CC} = 5.5 V	-	-	10.0	μA
ΔI_{CC}	additional supply current	$V_I = V_{CC} - 2.1$ V; V_{CC} = 4.5 V to 5.5 V; I_O = 0 μA	-	-	375	μA
T_{amb} = –40 °C to +125 °C						
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = –20 μA; V_{CC} = 4.5 V	4.4	-	-	V
		I_O = –4.0 mA; V_{CC} = 4.5 V	3.7	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = 20 μA; V_{CC} = 4.5 V	-	-	0.1	V
		I_O = 4.0 mA; V_{CC} = 4.5 V	-	-	0.4	V
I_I	input leakage current	V_I = GND or V_{CC}; V_{CC} = 5.5 V	-	-	±1.0	μA
I_{CC}	supply current	V_I = GND or V_{CC}; I_O = 0 μA; V_{CC} = 5.5 V	-	-	20.0	μA
ΔI_{CC}	additional supply current	$V_I = V_{CC} - 2.1$ V; V_{CC} = 4.5 V to 5.5 V; I_O = 0 μA	-	-	410	μA

12. Dynamic characteristics

Table 9. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 6.

Symbol	Parameter	Conditions	25 °C			–40 °C to +125 °C			Unit
			Min	Typ	Max	Min	Max (85 °C)	Max (125 °C)	
74HC2G14									
t_{pd}	propagation delay	nA to nY; see Figure 5 [1]							
		V_{CC} = 2.0 V; C_L = 50 pF	-	53	125	-	155	190	ns
		V_{CC} = 4.5 V; C_L = 50 pF	-	16	25	-	31	38	ns
		V_{CC} = 6.0 V; C_L = 50 pF	-	13	21	-	26	32	ns
t_t	transition time	nY; see Figure 5 [2]							
		V_{CC} = 2.0 V; C_L = 50 pF	-	20	75	-	95	110	ns
		V_{CC} = 4.5 V; C_L = 50 pF	-	7	15	-	19	22	ns
		V_{CC} = 6.0 V; C_L = 50 pF	-	5	13	-	16	19	ns
C_{PD}	power dissipation capacitance	V_I = GND to V_{CC} [3]	-	10	-	-	-	-	pF
74HCT2G14									
t_{pd}	propagation delay	nA to nY; see Figure 5 [1]							
		V_{CC} = 4.5 V; C_L = 50 pF	-	21	32	-	40	48	ns
t_t	transition time	nY; see Figure 5 [2]							
		V_{CC} = 4.5 V; C_L = 50 pF	-	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;

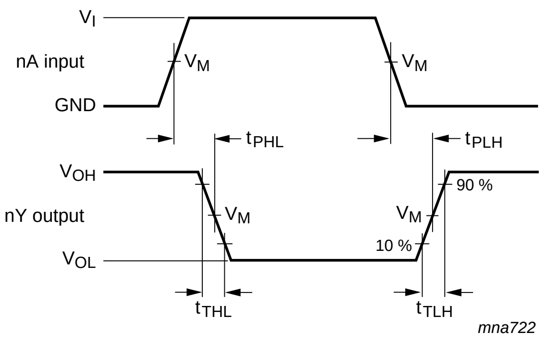
C_L = output load capacitance in pF;

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.

13. Waveforms



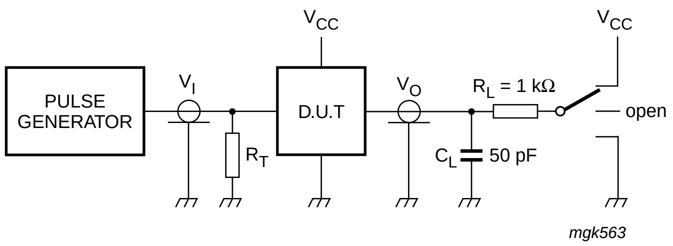
Measurement points are given in Table 10.

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

Fig 5. The data input (nA) to output (nY) propagation delays and output transition times

Table 10. Measurement points

Type	Input			Output
	V_M	V_I	$t_r = t_f$	V_M
74HC2G14	$0.5V_{CC}$	GND to V_{CC}	6.0 ns	$0.5V_{CC}$
74HCT2G14	1.3 V	GND to 3.0 V	6.0 ns	1.3 V



Test data is given in Table 11.

Definitions 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 6. Load circuitry for switching times

Table 11. Test data

Type	Input		Test
	V_I	t_r, t_f	t_{PHL}, t_{PLH}
74HC2G14	GND to V_{CC}	6 ns	open
74HCT2G14	GND to 3.0 V	6 ns	open

14. Transfer characteristics

Table 12. Transfer characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 6.

Symbol	Parameter	Conditions	25 °C			–40 °C to +125 °C			Unit
			Min	Typ	Max	Min	Max (85 °C)	Max (125 °C)	
74HC2G14									
V_{T+}	positive-going threshold voltage	see Figure 7, Figure 8							
		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 Figure 7, Figure 8							
		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 Figure 7, Figure 8 and Figure 9							
		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
74HCT2G14									
V_{T+}	positive-going threshold voltage	see Figure 7 and Figure 8							
		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 Figure 7 and Figure 8							
		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 Figure 7, Figure 8 and Figure 10							
		V_{CC} = 4.5 V	0.40	0.71	-	0.40	-	-	V
		V_{CC} = 5.5 V	0.40	0.67	-	0.40	-	-	V

15. Waveforms transfer characteristics

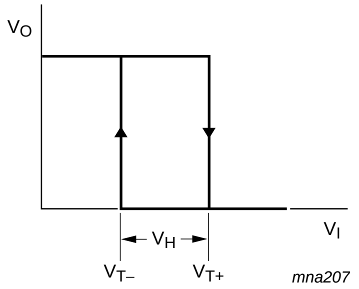


Fig 7. Transfer characteristic

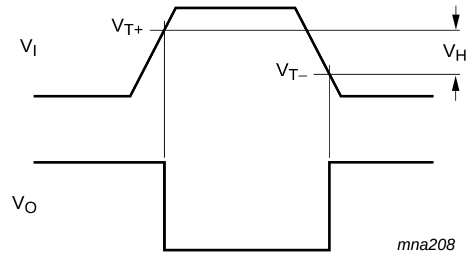
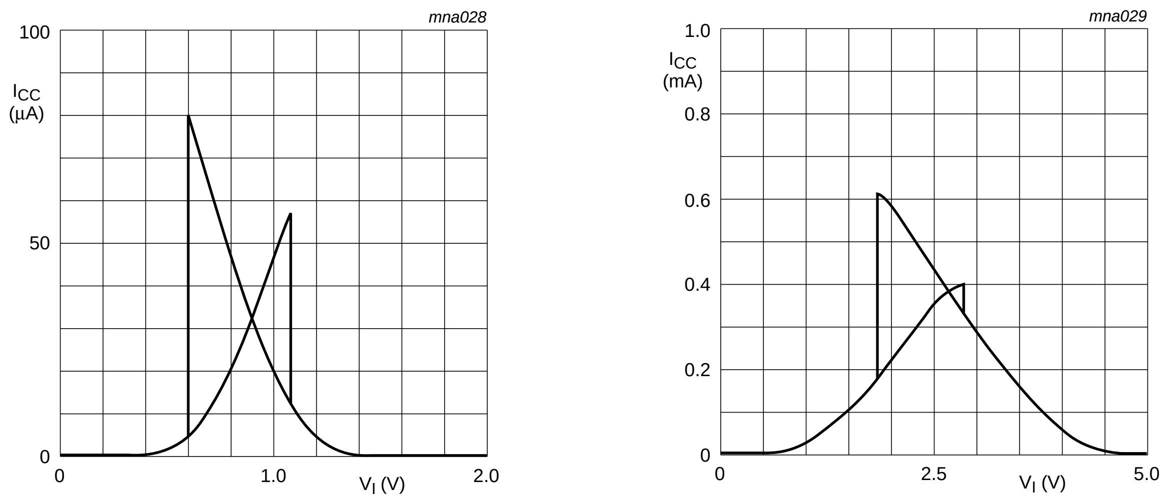
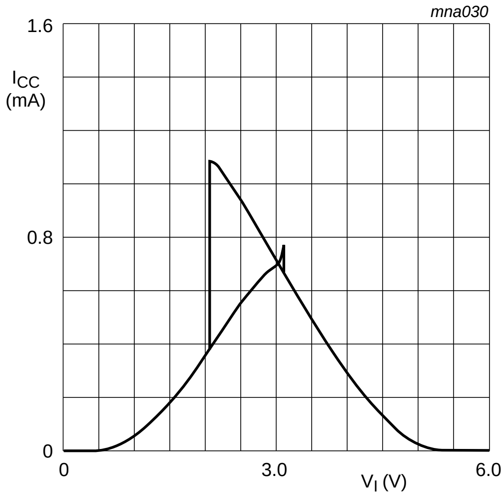


Fig 8. Definition of V_{T+}, V_{T-} and V_H



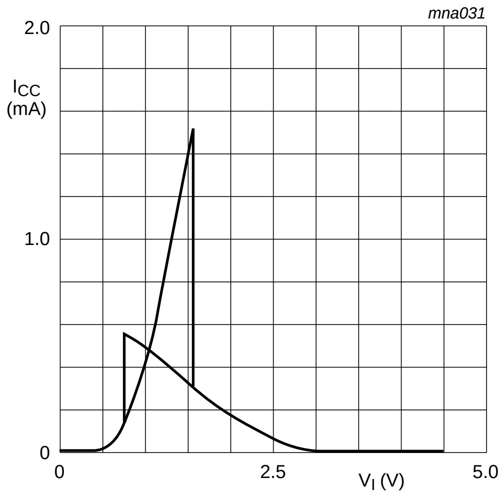
a. V_{CC} = 2.0 V

b. V_{CC} = 4.5 V

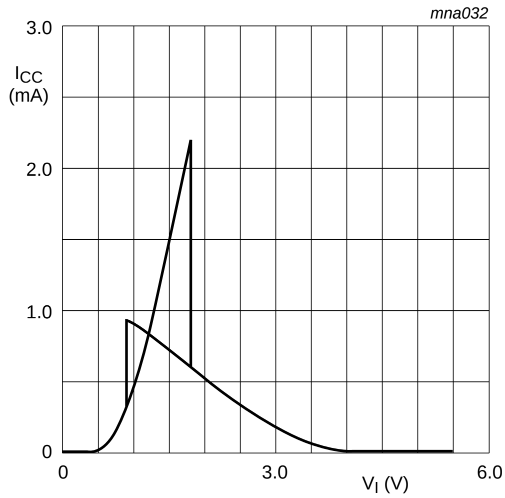


c. V_{CC} = 6.0 V

Fig 9. Typical 74HC2G14 transfer characteristics



a. V_{CC} = 4.5 V.



b. V_{CC} = 5.5 V.

Fig 10. Typical 74HCT2G14 transfer characteristics

16. 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);

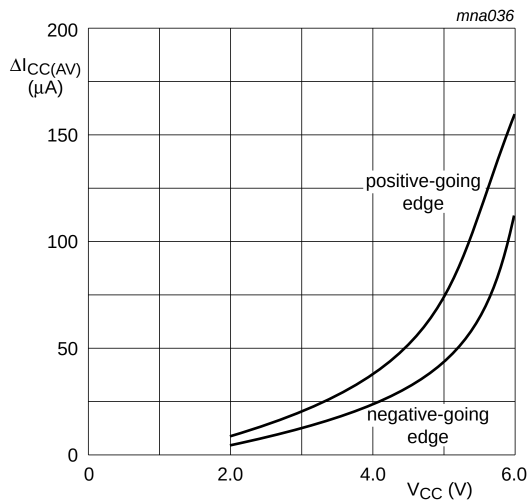
t_r = input rise time (ns); 10 % to 90 %;

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 Figure 11 and Figure 12.

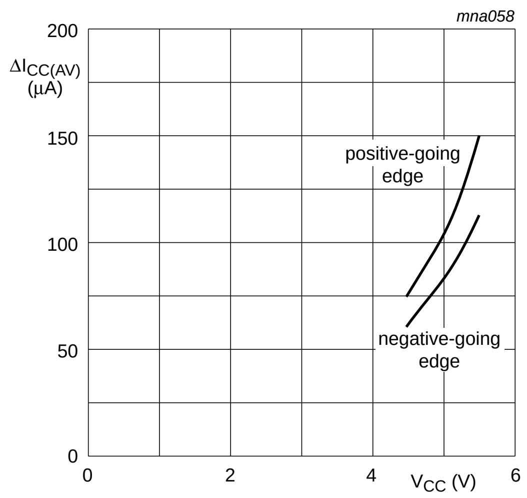
An example of a relaxation circuit using the 74HC2G14/74HCT2G14 is shown in Figure 13.



(1) Positive-going edge.

(2) Negative-going edge.

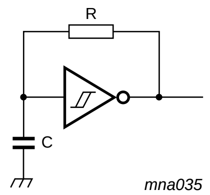
Fig 11. $\Delta I_{CC(AV)}$ as a function of V_{CC} for 74HC2G14; linear change of V_I between $0.1V_{CC}$ to $0.9V_{CC}$



(1) Positive-going edge.

(2) Negative-going edge.

Fig 12. $\Delta I_{CC(AV)}$ as a function of V_{CC} for 74HCT2G14; linear change of V_I between $0.1V_{CC}$ to $0.9V_{CC}$

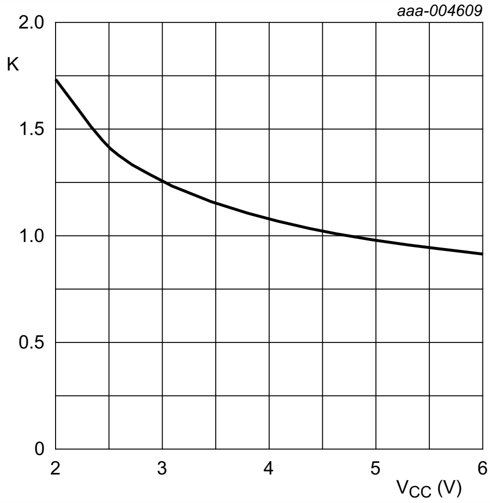


For 74HC2G14: $f = \frac{1}{T} \approx \frac{1}{0.8 \times RC}$

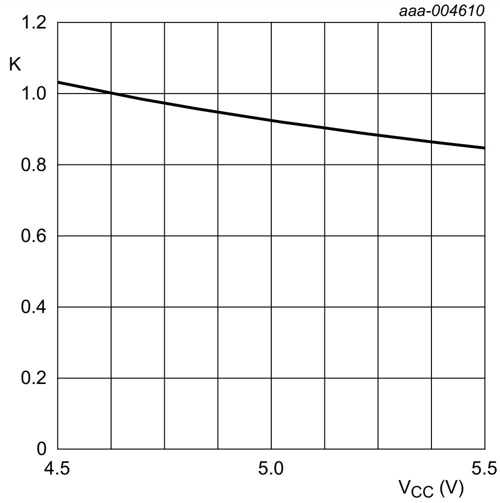
For 74HCT2G14: $f = \frac{1}{T} \approx \frac{1}{0.67 \times RC}$

For K-factor, see Figure 14

Fig 13. Relaxation oscillator



K-factor for 74HC2G14

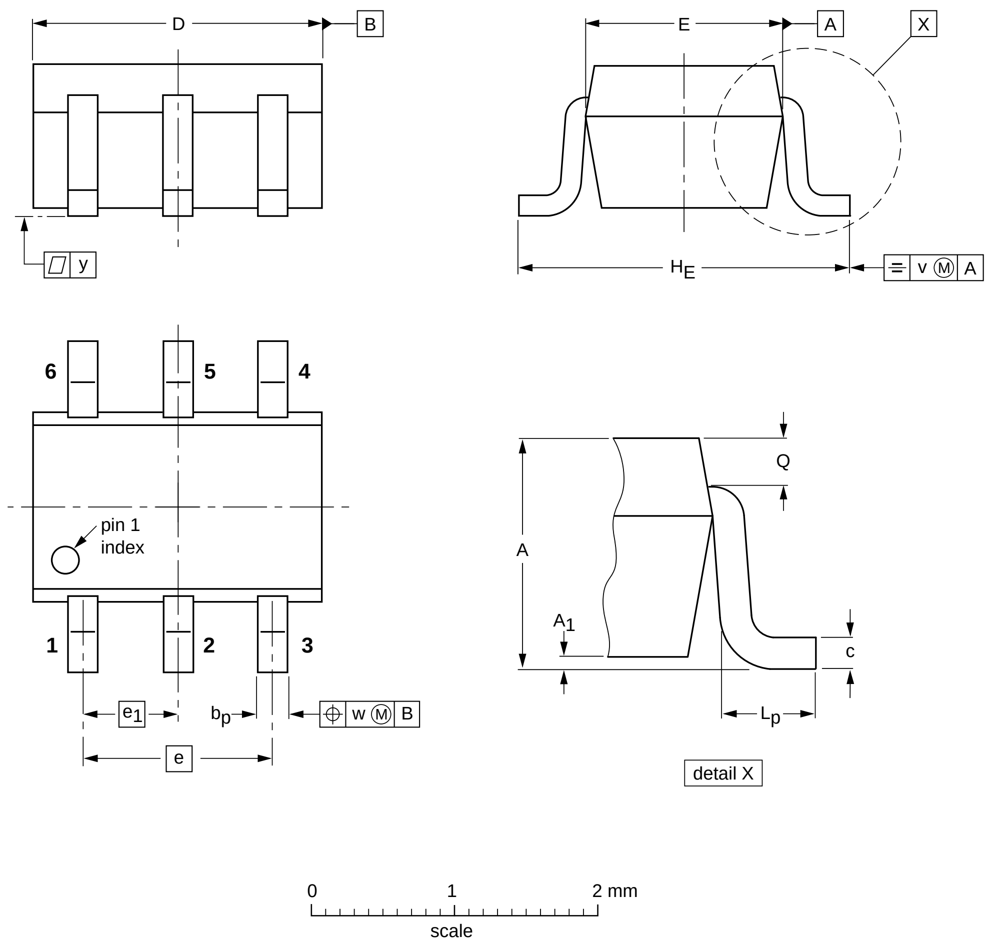


K-factor for 74HCT2G14

Fig 14. Typical K-factor for relaxation oscillator

17. Package outline

Plastic surface-mounted package; 6 leads **SOT363**



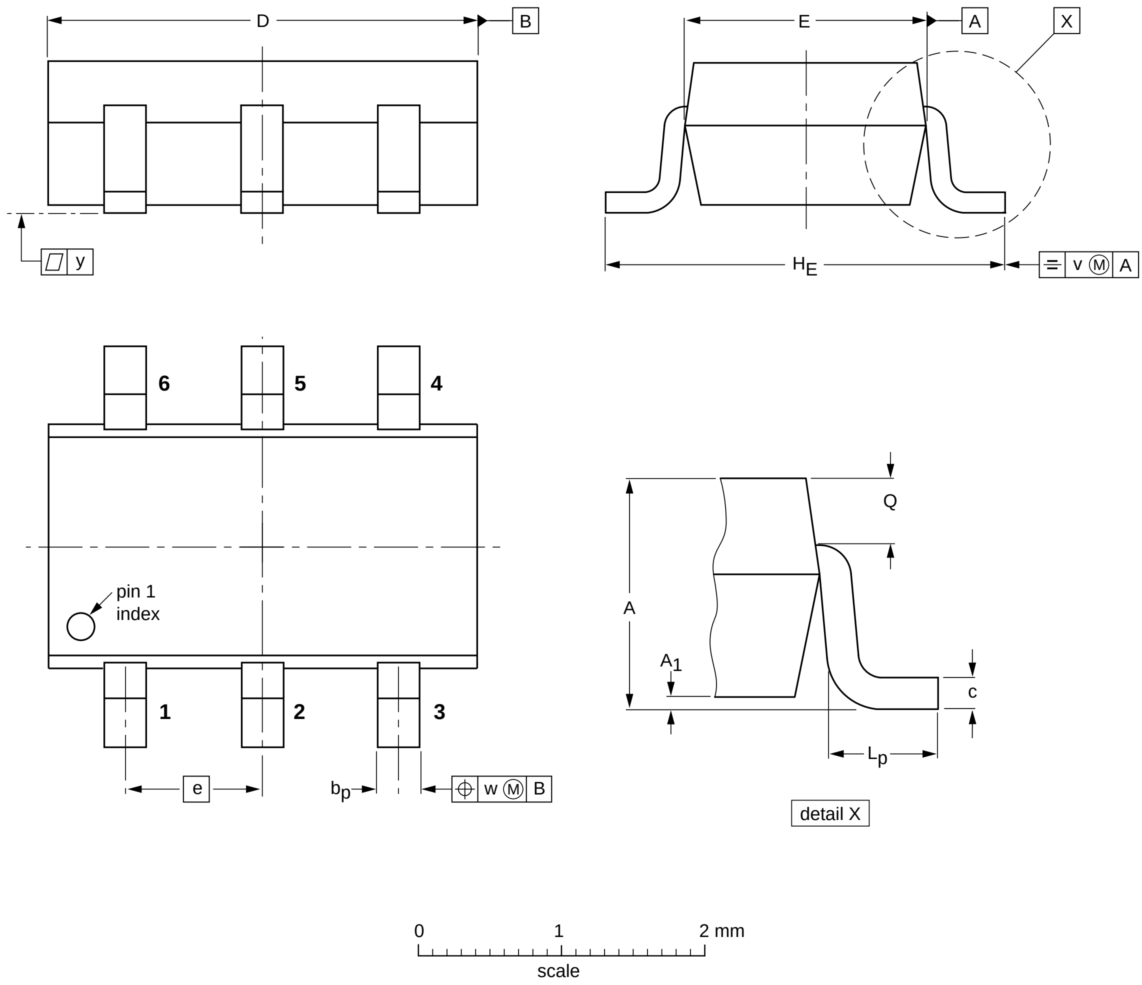
DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT363			SC-88			~~04-11-08~~ 06-03-16

Fig 15. Package outline SOT363 (SC-88)

Plastic surface-mounted package (TSOP6); 6 leads **SOT457**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	c	D	E	e	H_E	L_p	Q	v	w	y
mm	1.1 0.9	0.1 0.013	0.40 0.25	0.26 0.10	3.1 2.7	1.7 1.3	0.95	3.0 2.5	0.6 0.2	0.33 0.23	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT457			SC-74			~~05-11-07~~ 06-03-16

Fig 16. Package outline SOT457 (SC-74)

18. Abbreviations

Table 13. Abbreviations

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

19. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT2G14 v.2	20140314	Product data sheet	-	74HC_HCT2G14 v.1
Modifications:	• Figure 14 added (typical K-factor for relaxation oscillator).			
74HC_HCT2G14 v.1	20061011	Product data sheet	-	-

20. Legal information

20.1 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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Date of release: 14 March 2014