

74HC2G14-Q100; 74HCT2G14-Q100

Dual inverting Schmitt trigger

Rev. 1 — 20 March 2014

Product data sheet

1. General description

The 74HC2G14-Q100; 74HCT2G14-Q100 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.

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 $+85\text{ °C}$ and from -40 °C to $+125\text{ °C}$
- Wide supply voltage range from 2.0 V to 6.0 V
- Complies with JEDEC standard no. 7A
- Input levels:
 - ◆ For 74HC2G14-Q100: CMOS level
 - ◆ For 74HCT2G14-Q100: TTL level
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- Unlimited input rise and fall times
- ESD protection:
 - ◆ MIL-STD-883, method 3015 exceeds 2000 V
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V ($C = 200\text{ pF}$, $R = 0\text{ }\Omega$)
- Multiple package options

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
74HC2G14GW-Q100	-40 °C to +125 °C	SC-88	plastic surface-mounted package; 6 leads	SOT363
74HC2G14GV-Q100	-40 °C to +125 °C	SC-74	plastic surface-mounted package (TSOP6); 6 leads	SOT457
74HCT2G14GW-Q100	-40 °C to +125 °C	SC-88	plastic surface-mounted package; 6 leads	SOT363
74HCT2G14GV-Q100	-40 °C to +125 °C	SC-74	plastic surface-mounted package (TSOP6); 6 leads	SOT457

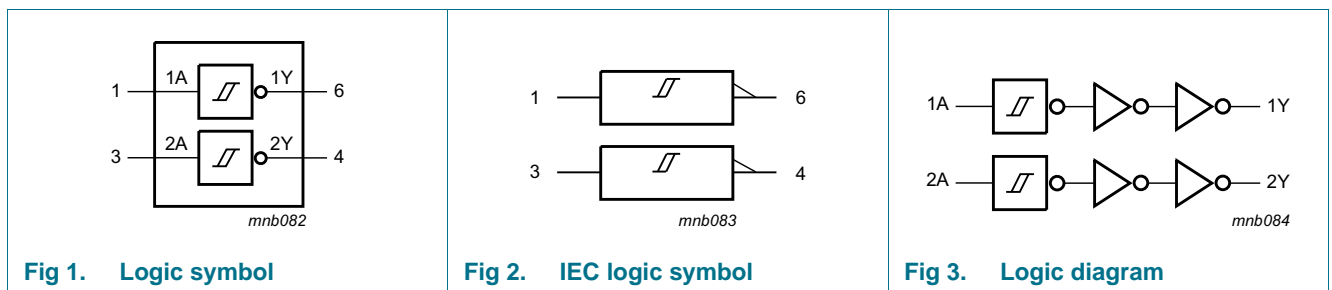
5. Marking

Table 2. Marking codes

Type number	Marking code ^[1]
74HC2G14GW-Q100	HK
74HC2G14GV-Q100	H14
74HCT2G14GW-Q100	TK
74HCT2G14GV-Q100	T14

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

6. Functional diagram



7. Pinning information

7.1 Pinning

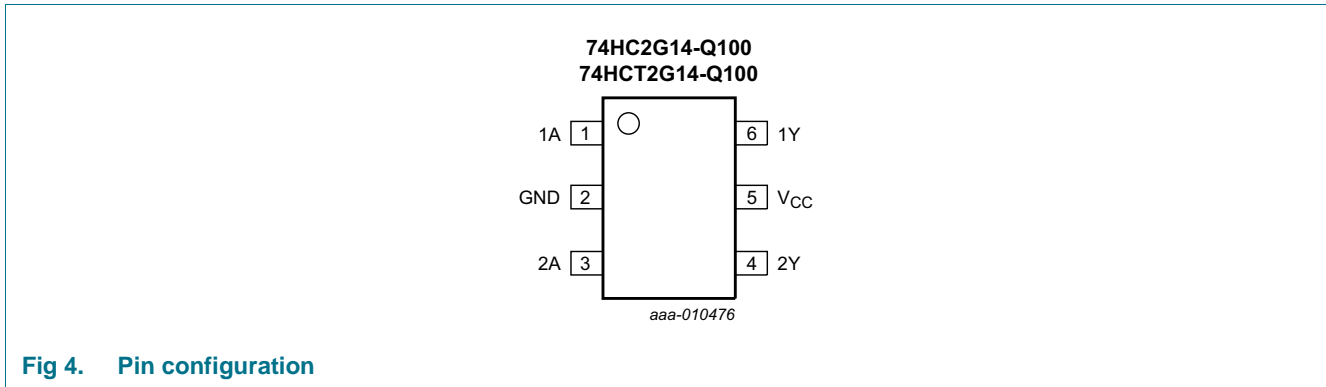


Fig 4. Pin configuration

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	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	[1]	-	±20 mA
I_{OK}	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	[1]	-	±20 mA
I_O	output current	$V_O = -0.5\text{ V}$ to $V_{CC} + 0.5\text{ V}$	[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
74HC2G14-Q100						
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
74HCT2G14-Q100						
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-Q100

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-Q100 ...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-Q100

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-Q100 ...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 characteristicsVoltages 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-Q100									
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 [1]							
		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} [2]	-	10	-	-	-	-	pF

Table 9. Dynamic characteristics ...continued

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)	
74HCT2G14-Q100									
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 [1]							
		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 [2]	-	10	-	-	-	-	pF

- [1] t_{pd} is the same as t_{PLH} and t_{PHL}; t_t is the same as t_{TLH} and t_{THL}.
- [2] 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;
 Σ(C_L × V_{CC}² × f_o) = sum of the outputs.

13. Waveforms and test circuit

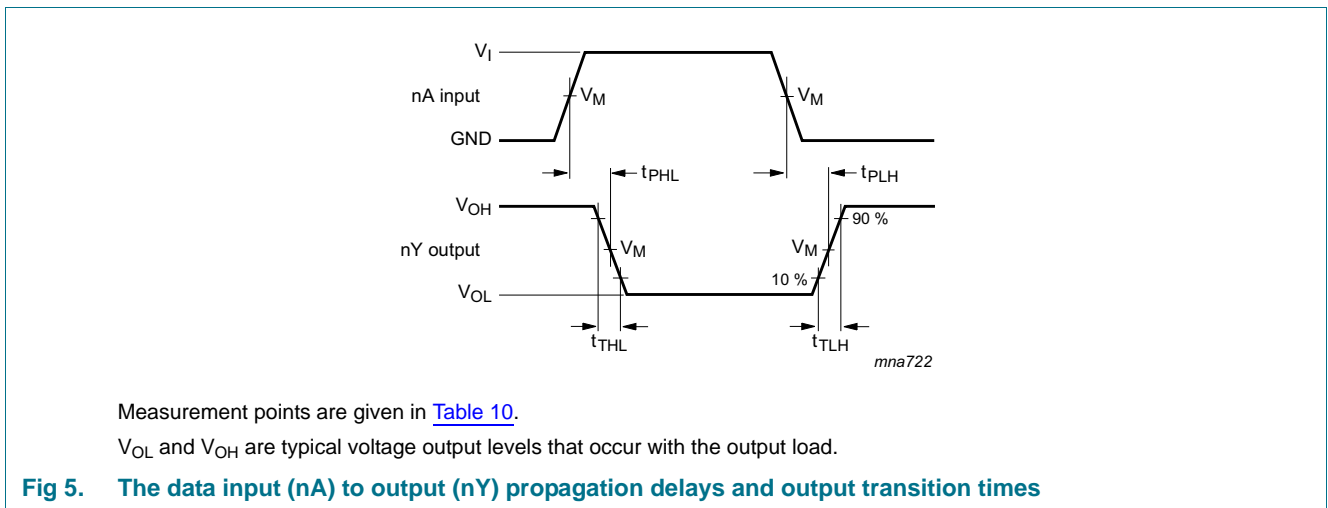


Table 10. Measurement points

Type	Input	Output
	V _M	V _M
74HC2G14-Q100	0.5V _{CC}	0.5V _{CC}
74HCT2G14-Q100	1.3 V	1.3 V



Test data is given in [Table 11](#).

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 6. Test circuit for measuring switching times

Table 11. Test data

Type	Input		Test
	V_I	t_r, t_f	
74HC2G14-Q100	GND to V_{CC}	6 ns	open
74HCT2G14-Q100	GND to 3.0 V	6 ns	open

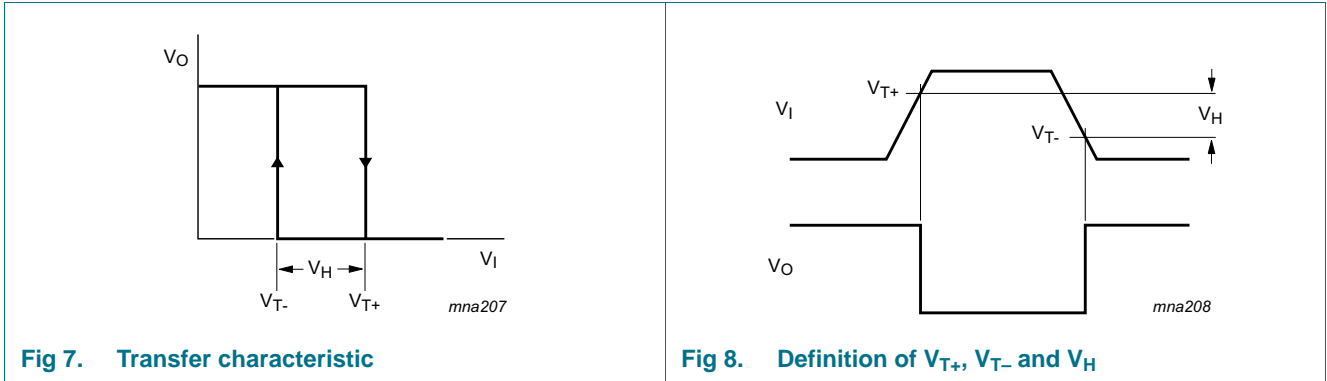
14. Transfer characteristics

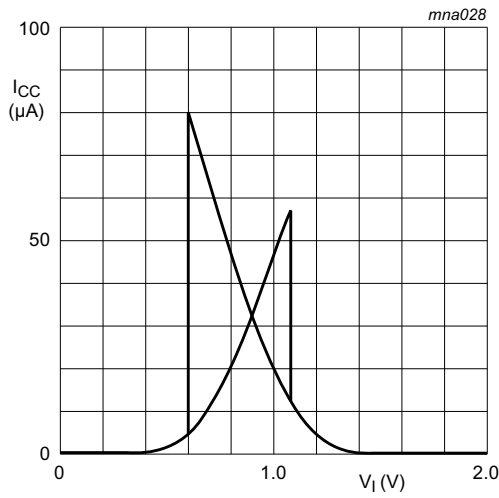
Table 12. Transfer characteristics

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

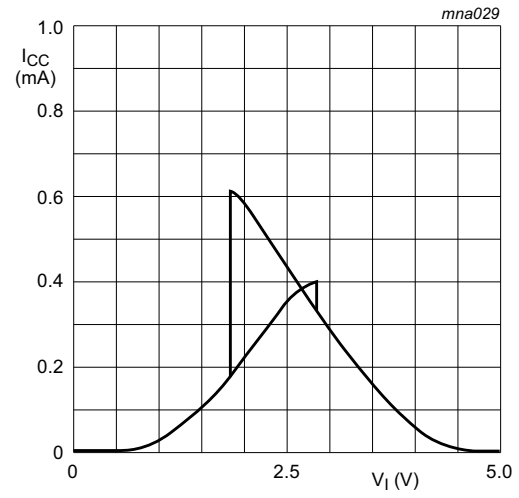
Symbol	Parameter	Conditions	25 °C			–40 °C to +125 °C			Unit
			Min	Typ	Max	Min	Max (85 °C)	Max (125 °C)	
74HC2G14-Q100									
V _{T+}	positive-going threshold voltage	see Figure 7 and Figure 8							
		V _{CC} = 2.0 V	1.00	1.18	1.50	1.00	1.50	1.50	V
		V _{CC} = 4.5 V	2.30	2.60	3.15	2.30	3.15	3.15	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 and 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-Q100									
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

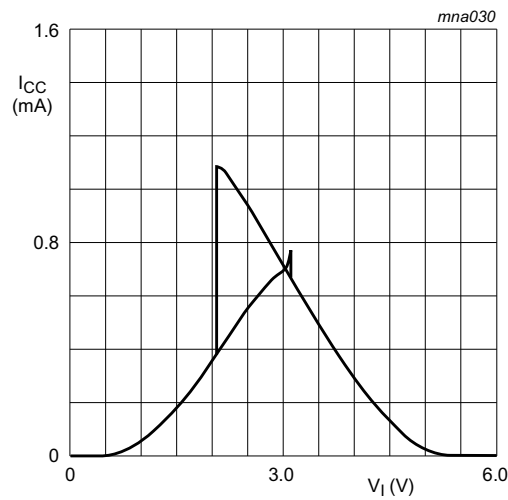




a. $V_{CC} = 2.0\text{ V}$



b. $V_{CC} = 4.5\text{ V}$



c. $V_{CC} = 6.0\text{ V}$

Fig 9. Typical 74HC2G14-Q100 transfer characteristics

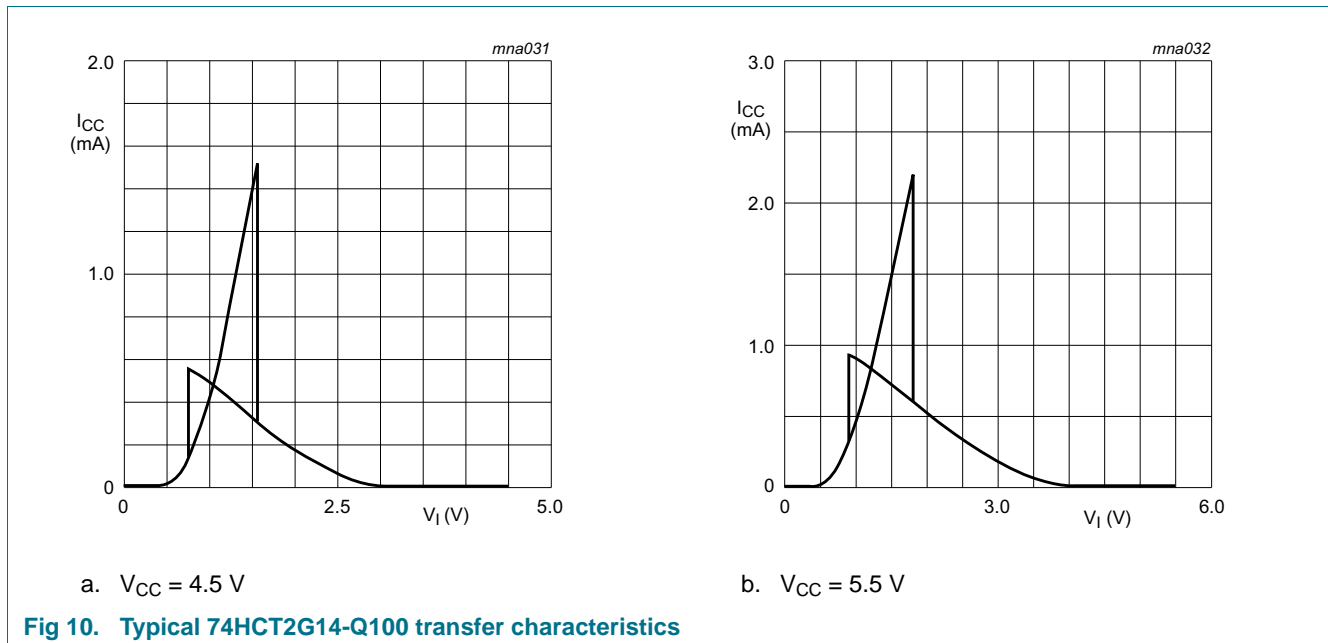


Fig 10. Typical 74HCT2G14-Q100 transfer characteristics

16. Application information

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

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

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 %;

$\Delta I_{CC(\text{AV})}$ = average additional supply current (μA).

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

An example of a relaxation circuit using the 74HC2G14-Q100; 74HCT2G14-Q100 is shown in [Figure 13](#).

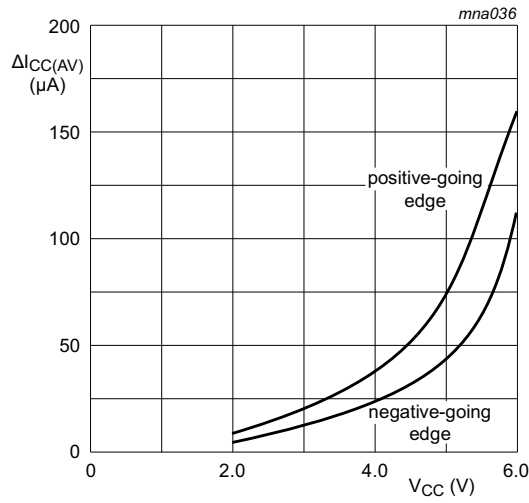


Fig 11. $\Delta I_{CC(AV)}$ as a function of V_{CC} for 74HC2G14-Q100; linear change of V_I between $0.1V_{CC}$ to $0.9V_{CC}$

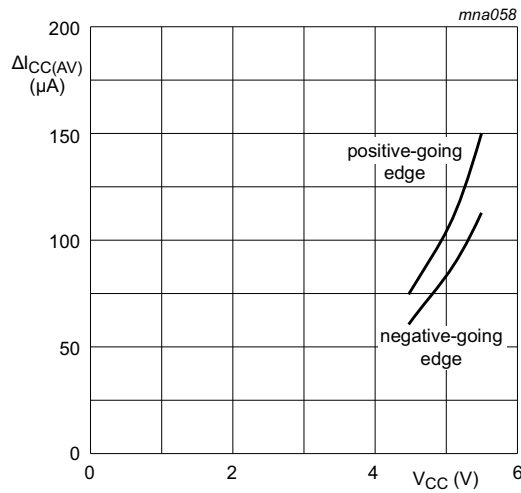
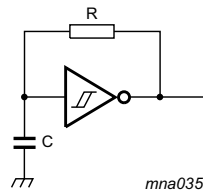


Fig 12. $\Delta I_{CC(AV)}$ as a function of V_{CC} for 74HCT2G14-Q100; linear change of V_I between $0.1V_{CC}$ to $0.9V_{CC}$

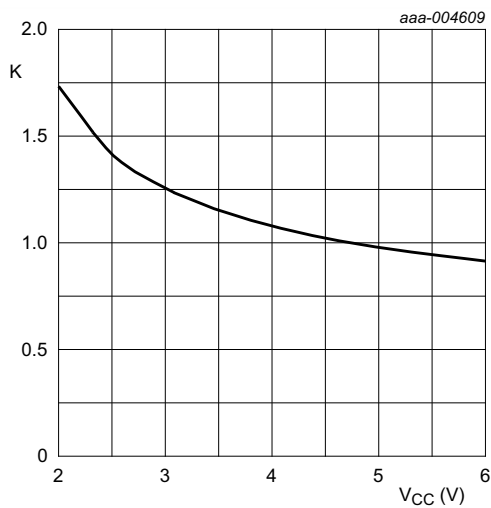


For 74HC2G14-Q100: $f = \frac{1}{T} \approx \frac{1}{0.8 \times RC}$

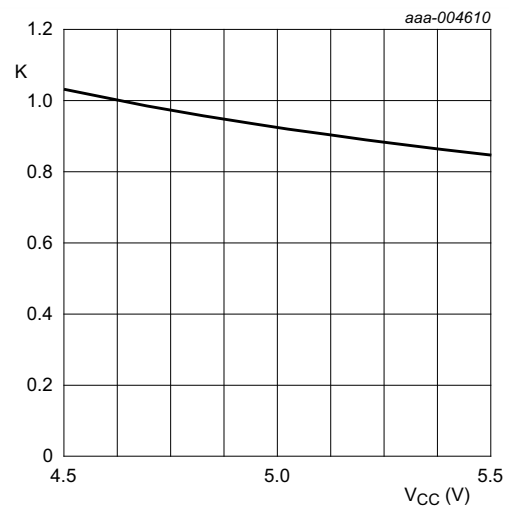
For 74HCT2G14-Q100: $f = \frac{1}{T} \approx \frac{1}{0.67 \times RC}$

For K-factor, see [Figure 14](#)

Fig 13. Relaxation oscillator



a. K-factor for 74HC2G14-Q100



b. K-factor for 74HCT2G14-Q100

Fig 14. Typical K-factor for relaxation oscillator

17. Package outline

Plastic surface-mounted package; 6 leads

SOT363

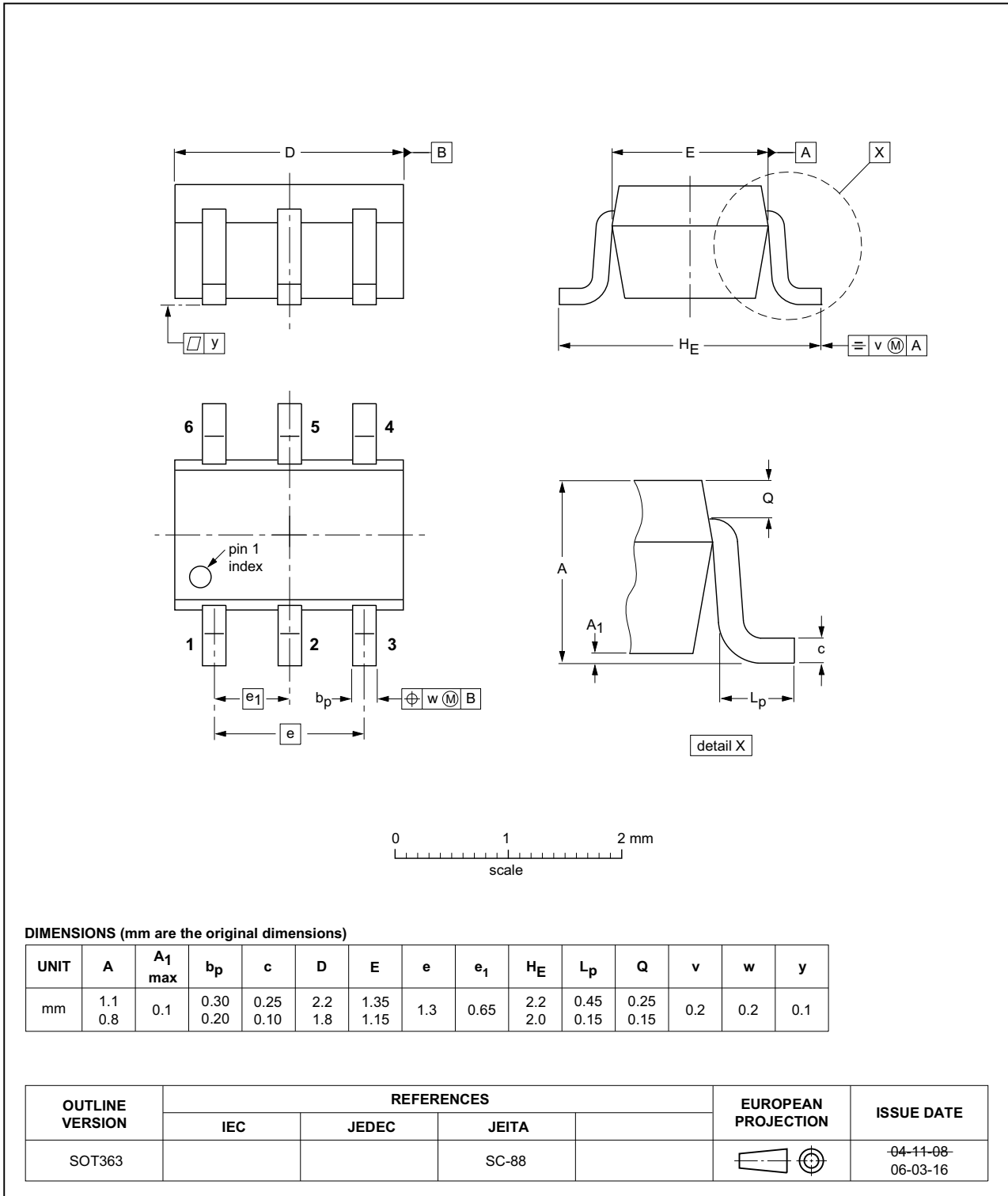


Fig 15. Package outline SOT363 (SC-88)

Plastic surface-mounted package (TSOP6); 6 leads

SOT457

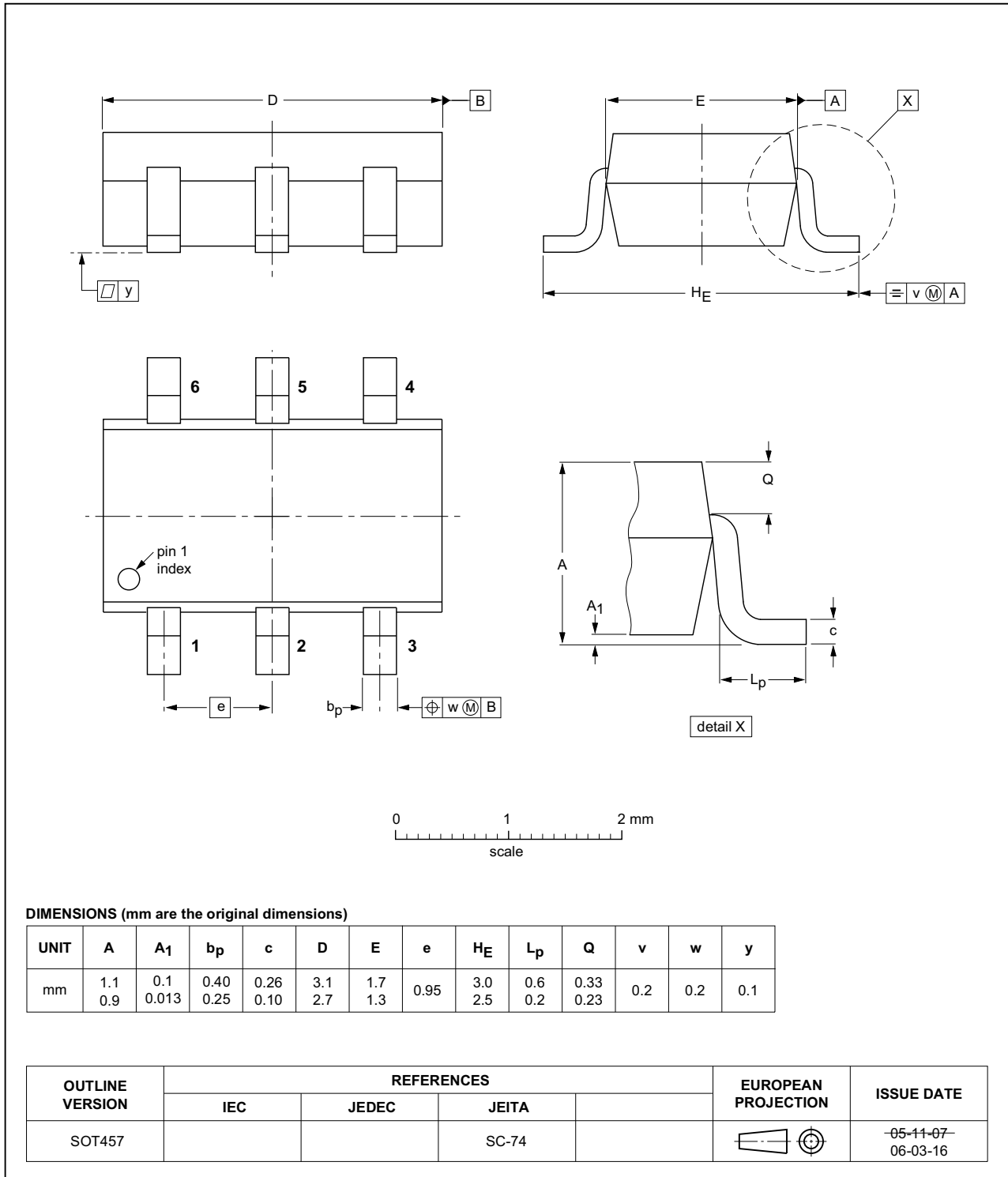


Fig 16. Package outline SOT457 (SC-74)

18. Abbreviations

Table 13. 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

19. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT2G14_Q100 v.1	20140320	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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