

# 74HC9114; 74HCT9114

Nine wide Schmitt trigger buffer; open drain outputs;  
inverting

Rev. 3 — 2 October 2017

Product data sheet

## 1 General description

The 74HC9114; 74HCT9114 is a 9-bit inverter with Schmitt trigger inputs and open drain outputs. 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.

## 2 Features and benefits

- Wide operating voltage 2.0 V to 6.0 V
- Schmitt trigger action on all data inputs
- Low-power dissipation
- Complies with JEDEC standard no. 7A
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

## 3 Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC9114D	-40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74HCT9114D				

## 4 Functional diagram

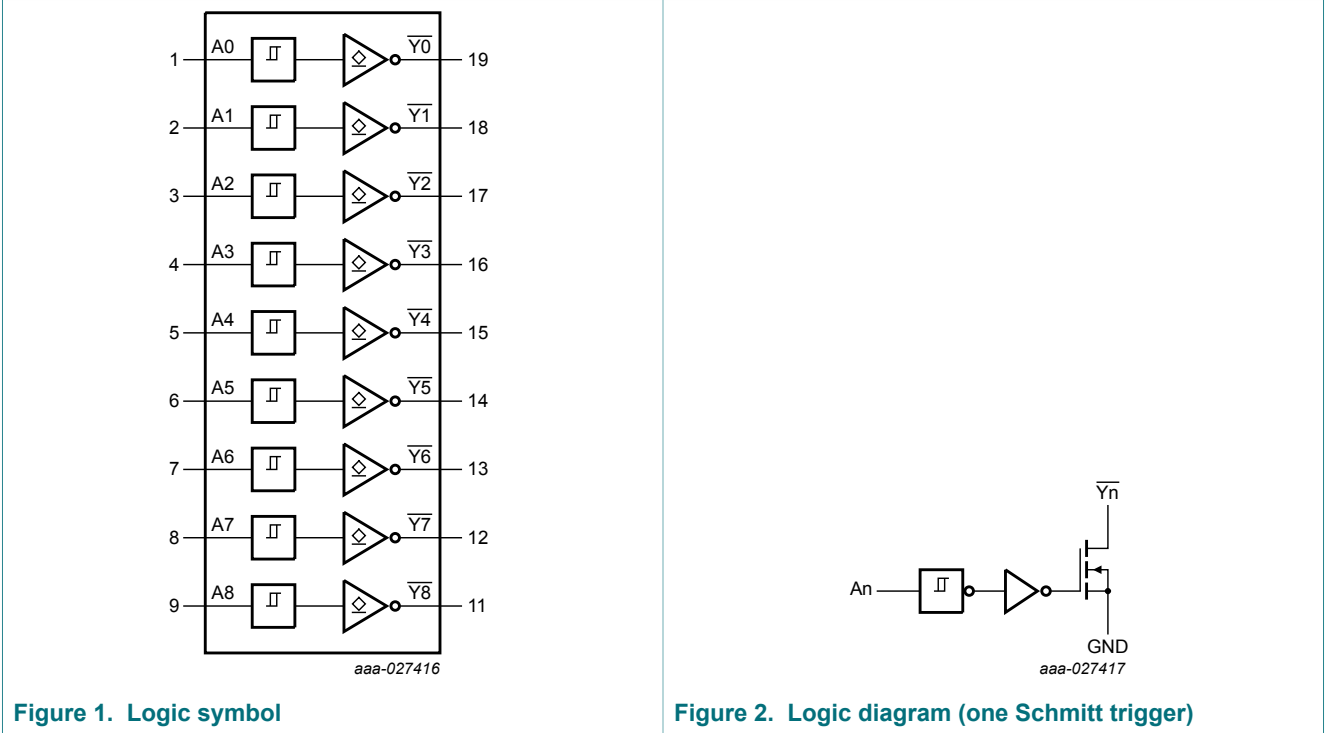


Figure 1. Logic symbol

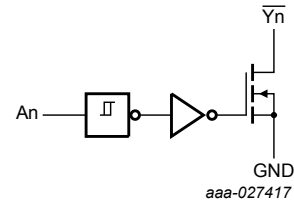


Figure 2. Logic diagram (one Schmitt trigger)

## 5 Pinning information

### 5.1 Pinning

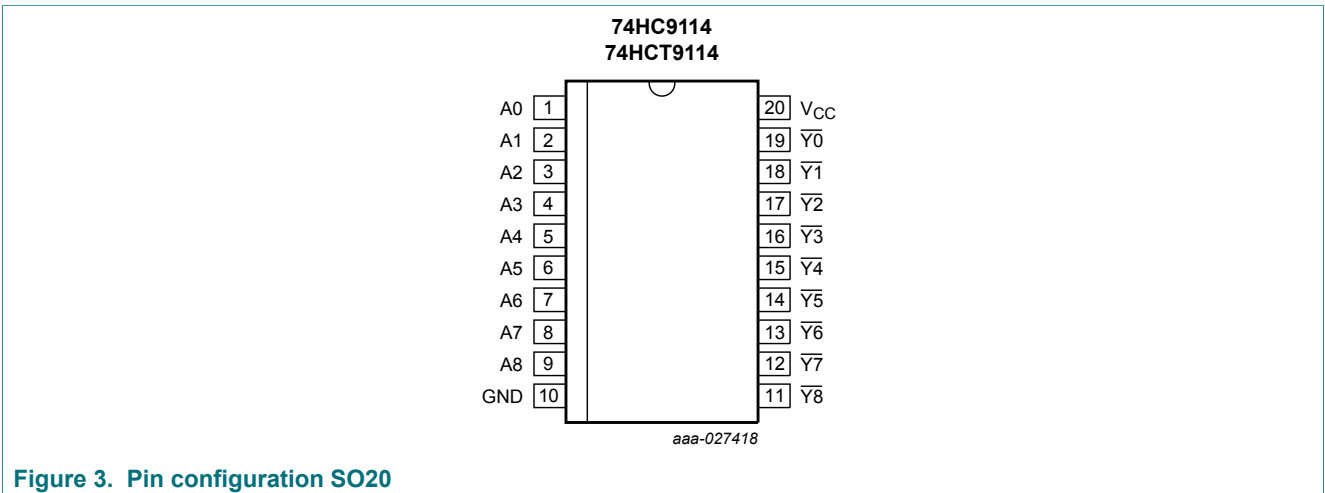


Figure 3. Pin configuration SO20

## 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
A0, A1, A2, A3, A4, A5, A6, A7, A8	1, 2, 3, 4, 5, 6, 7, 8, 9	data input
GND	10	ground (0 V)
Y0, Y1, Y2, Y3, Y4, Y5, Y6, Y7, Y8	19, 18, 17, 16, 15, 14, 13, 12, 11	data output
V <sub>CC</sub>	20	supply voltage

## 6 Functional description

Table 3. Function table <sup>[1]</sup>

Input	Output
A <sub>n</sub>	Y <sub>n</sub>
L	Z
H	L

[1] H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

## 7 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 <sub>CC</sub>	supply voltage		-0.5	+7.0	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V <sup>[1]</sup>	-	±20	mA
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V <sup>[1]</sup>	-	±20	mA
I <sub>O</sub>	output current	-0.5 V < V <sub>O</sub> < V <sub>CC</sub> + 0.5 V <sup>[1]</sup>	-	±25	mA
I <sub>CC</sub>	supply current		-	50	mA
I <sub>GND</sub>	ground current		-50	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C <sup>[2]</sup>	-	500	mW

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

[2] Above 70 °C the value of P<sub>tot</sub> derates linearly with 8 mW/K.

## 8 Recommended operating conditions

**Table 5. Recommended operating conditions**

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

Symbol	Parameter	Conditions	74HC9114			74HCT9114			Unit
			Min	Typ	Max	Min	Typ	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V <sub>I</sub>	input voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
V <sub>O</sub>	output voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	-40	+25	+125	°C

## 9 Static characteristics

**Table 6. Static characteristics**

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +85 °C		T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HC9114</b>										
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub>								
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub>								
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V	-	-	8.0	-	80	-	160	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +85 °C		T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HCT9114</b>										
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = -20 μA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4.0 mA	3.98	4.32	-	3.84	-	3.7	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = 20 μA;	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA;	-	0.15	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	-	8.0	-	80	-	160	μA
ΔI <sub>CC</sub>	additional supply current	per An input pin; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 4.5 V to 5.5 V; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other inputs at V <sub>CC</sub> or GND	-	30	108	-	135	-	147	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

## 10 Dynamic characteristics

Table 7. Dynamic characteristics

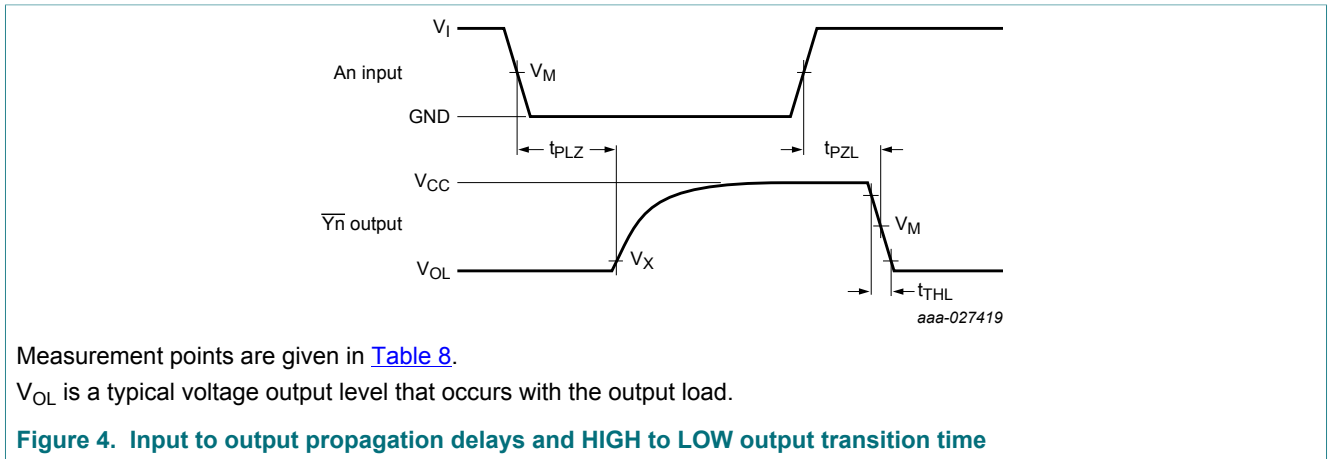
GND = 0 V; C<sub>L</sub> = 50 pF; for test circuit see Figure 5.

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ	Max	Max (85 °C)	Max (125 °C)	
<b>74HC9114</b>								
t <sub>pd</sub>	propagation delay	An to $\overline{Yn}$ ; see Figure 4 <sup>[1]</sup>						
		V <sub>CC</sub> = 2.0 V	-	36	110	140	165	ns
		V <sub>CC</sub> = 4.5 V	-	13	22	28	33	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF	-	12	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	-	10	19	24	28	ns
t <sub>THL</sub>	HIGH to LOW output transition time	$\overline{Yn}$ ; see Figure 4						
		V <sub>CC</sub> = 2.0 V	-	19	75	95	110	ns
		V <sub>CC</sub> = 4.5 V	-	7	15	19	22	ns
		V <sub>CC</sub> = 6.0 V	-	6	13	16	19	ns
C <sub>PD</sub>	power dissipation capacitance	per buffer; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[2]</sup>	-	5	-	-	-	pF

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ	Max	Max (85 °C)	Max (125 °C)	
<b>74HCT9114</b>								
t <sub>pd</sub>	propagation delay	An to $\overline{Yn}$ ; see <a href="#">Figure 4</a> [1]						
		V <sub>CC</sub> = 4.5 V	-	17	31	39	47	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF	-	13	-	-	-	ns
t <sub>THL</sub>	HIGH to LOW output transition time	$\overline{Yn}$ ; V <sub>CC</sub> = 4.5 V; see <a href="#">Figure 4</a>	-	7	15	19	22	ns
C <sub>PD</sub>	power dissipation capacitance	per buffer; V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V [2]	-	5	-	-	-	pF

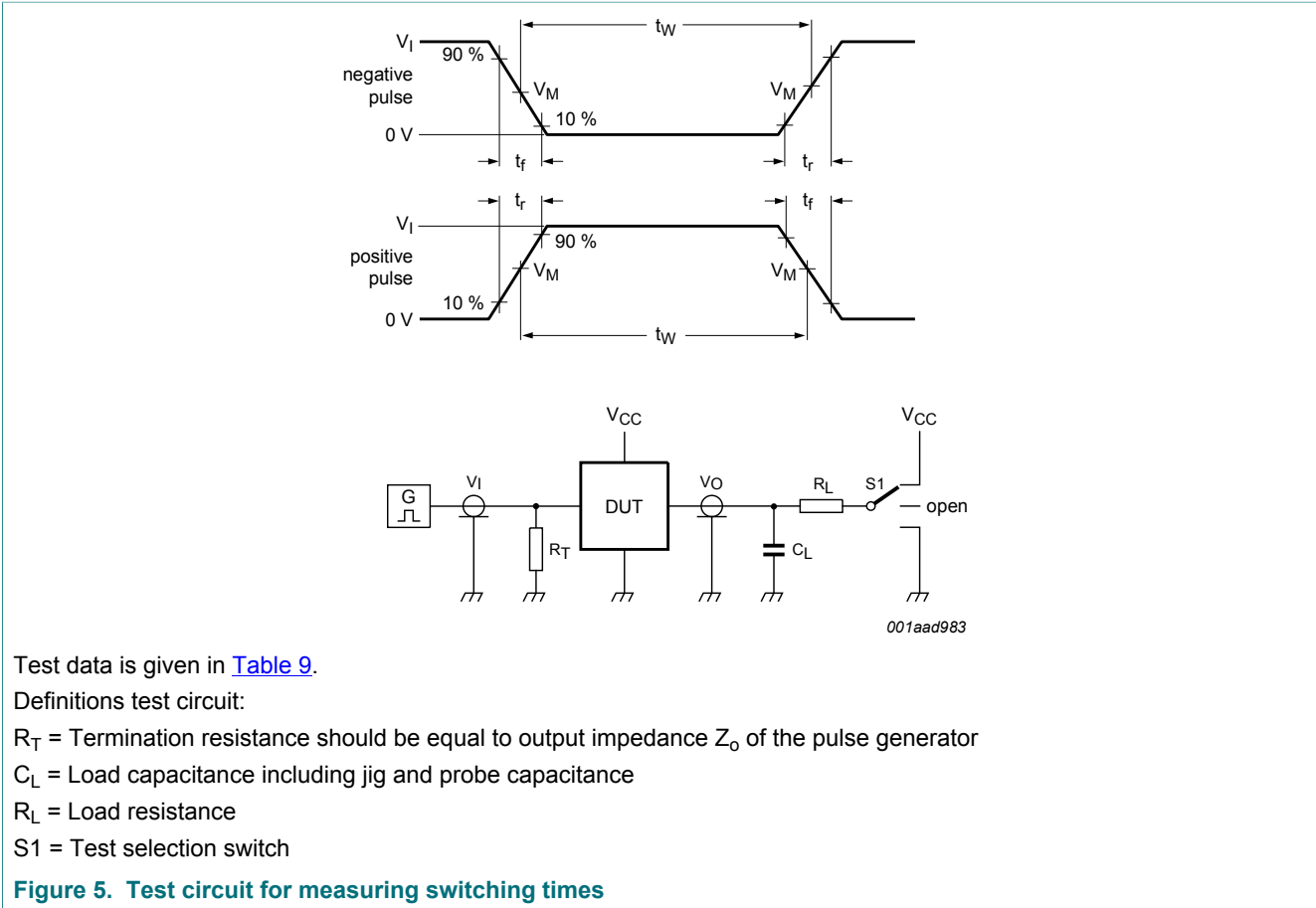
- [1] t<sub>pd</sub> is the same as t<sub>PLZ</sub> and t<sub>PZL</sub>.
- [2] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$  where:  
 f<sub>i</sub> = input frequency in MHz;  
 f<sub>o</sub> = output frequency in MHz;  
 C<sub>L</sub> = output load capacitance in pF;  
 V<sub>CC</sub> = supply voltage in V;  
 N = number of inputs switching;  
 $\sum (C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

## 10.1 Waveforms and test circuit



**Table 8. Measurement points**

Type	Input	Output	
	V <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>
74HC9114	0.5V <sub>CC</sub>	0.5V <sub>CC</sub>	0.1V <sub>CC</sub>
74HCT9114	1.3 V	1.3 V	0.1V <sub>CC</sub>



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

$R_L$  = Load resistance

S1 = Test selection switch

**Figure 5. Test circuit for measuring switching times**

**Table 9. Test data**

Type	Input		Load		S1 position	
	$V_I$	$t_r, t_f$	$C_L$	$R_L$		
74HC9114	$V_{CC}$	6 ns	15 pF, 50 pF	1 k $\Omega$	open	$V_{CC}$
74HCT9114	3 V	6 ns	15 pF, 50 pF	1 k $\Omega$	open	$V_{CC}$

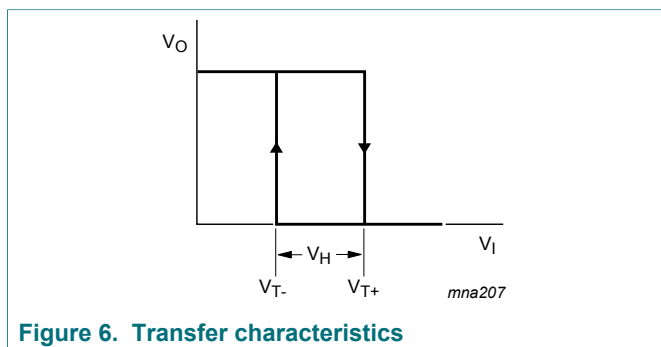
## 10.2 Transfer characteristics

**Table 10. Transfer characteristics**

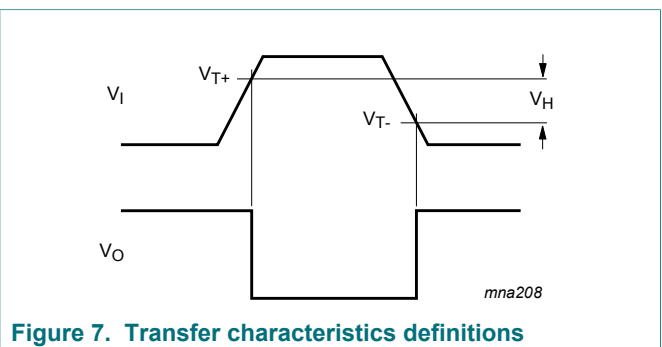
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see [Figure 6](#) and [Figure 7](#).

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +85 °C		T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HC9114</b>										
V <sub>T+</sub>	positive-going threshold voltage	V <sub>CC</sub> = 2.0 V	0.70	1.13	1.50	0.70	1.50	0.70	1.50	V
		V <sub>CC</sub> = 4.5 V	1.75	2.37	3.15	1.75	3.15	1.75	3.15	V
		V <sub>CC</sub> = 6.0 V	2.30	3.11	4.20	2.30	4.20	2.30	4.20	V
V <sub>T-</sub>	negative-going threshold voltage	V <sub>CC</sub> = 2.0 V	0.30	0.70	1.10	0.30	1.10	0.30	1.10	V
		V <sub>CC</sub> = 4.5 V	1.35	1.80	2.40	1.35	2.40	1.35	2.40	V
		V <sub>CC</sub> = 6.0 V	1.8	2.43	3.30	1.80	3.30	1.80	3.30	V
V <sub>H</sub>	hysteresis voltage	V <sub>CC</sub> = 2.0 V	0.2	0.43	0.80	0.18	0.80	0.15	0.80	V
		V <sub>CC</sub> = 4.5 V	0.4	0.57	1.00	0.40	1.00	0.40	1.00	V
		V <sub>CC</sub> = 6.0 V	0.5	0.68	1.10	0.50	1.10	0.50	1.10	V
<b>74HCT9114</b>										
V <sub>T+</sub>	positive-going threshold voltage	V <sub>CC</sub> = 4.5 V	0.9	1.50	2.0	0.9	2.0	0.9	2.0	V
		V <sub>CC</sub> = 5.5 V	1.2	1.70	2.1	1.2	2.1	1.2	2.1	V
V <sub>T-</sub>	negative-going threshold voltage	V <sub>CC</sub> = 4.5 V	0.7	1.06	1.4	0.7	1.4	0.7	1.4	V
		V <sub>CC</sub> = 5.5 V	0.8	1.27	1.7	0.8	1.7	0.8	2.7	V
V <sub>H</sub>	hysteresis voltage	V <sub>CC</sub> = 4.5 V	0.2	0.44	0.8	0.2	0.8	0.2	0.8	V
		V <sub>CC</sub> = 5.5 V	0.2	0.44	0.8	0.2	0.8	0.2	0.8	V

## 10.3 Transfer characteristics waveforms



**Figure 6. Transfer characteristics**



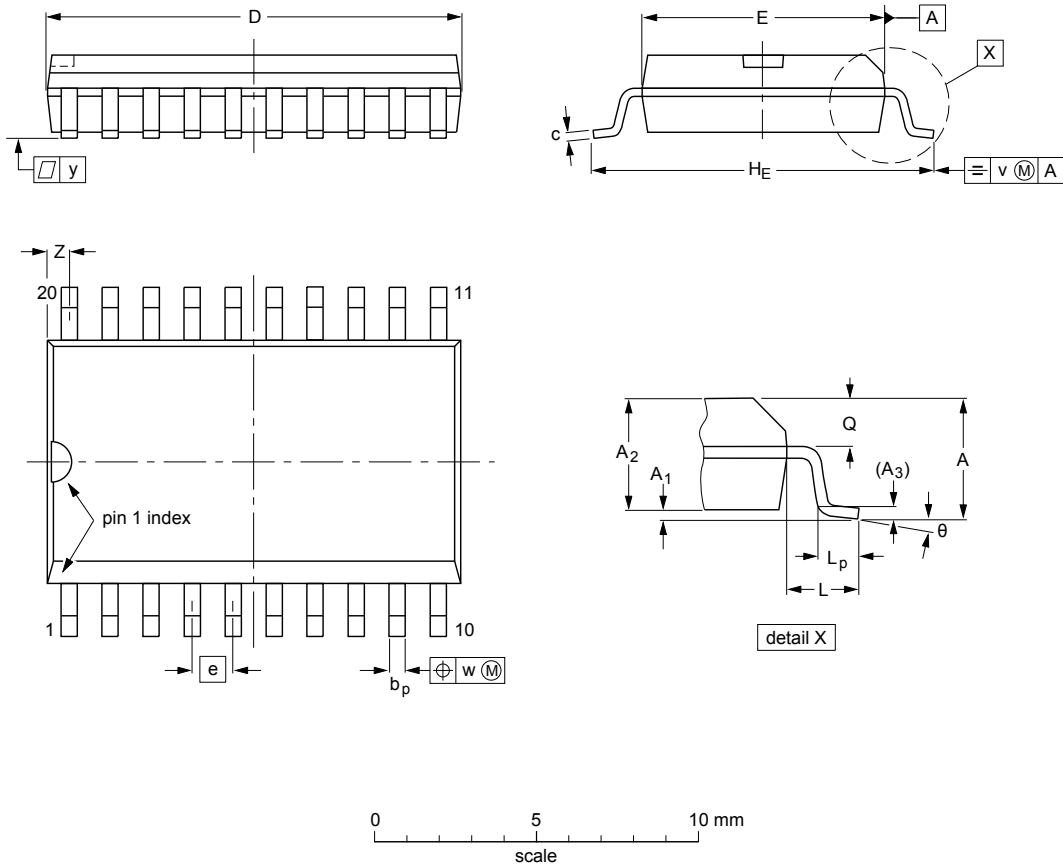
**Figure 7. Transfer characteristics definitions**



11 Package outline

SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.1	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.05	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

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

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA		
SOT163-1	075E04	MS-013			99-12-27 03-02-19

Figure 8. Package outline SOT163-1 (SO20)

## 12 Abbreviations

Table 11. Abbreviations

Acronym	Description
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

## 13 Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT9114 v.3	20171002	Product data sheet	-	74HC_HCT9114 v.2
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>			
74HC_HCT9114 v.2	19901201	Product specification	-	74HC_HCT9114 v.1
74HC_HCT9114 v.1	19880301	Product specification	-	-

## 14 Legal information

### 14.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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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