

# DATA SHEET

## **74AHC1G14; 74AHCT1G14** Inverting Schmitt trigger

Product specification  
File under Integrated Circuits, IC06

1999 Aug 05

## Inverting Schmitt trigger

## 74AHC1G14; 74AHCT1G14

## FEATURES

- Symmetrical output impedance
- High noise immunity
- ESD protection:  
HBM EIA/JESD22-A114-A exceeds 2000 V  
MM EIA/JESD22-A115-A exceeds 200 V
- Low power dissipation
- Balanced propagation delays
- Very small 5 pin package
- Output capability: standard.

## APPLICATIONS

- Wave and pulse shapers
- Astable multivibrators
- Monostable multivibrators.

## DESCRIPTION

The 74AHC1G/AHCT1G14 is a high-speed Si-gate CMOS device.

The 74AHC1G/AHCT1G14 provides the inverting buffer function with Schmitt-trigger action. These devices are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

## QUICK REFERENCE DATA

GND = 0 V;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $t_r = t_f \leq 3.0\text{ ns}$ .

SYMBOL	PARAMETER	CONDITIONS	TYPICAL		UNIT
			AHC1G	AHCT1G	
$t_{PHL}/t_{PLH}$	propagation delay inA to outY	$C_L = 15\text{ pF}$ ; $V_{CC} = 5\text{ V}$	3.2	4.1	ns
$C_I$	input capacitance		1.5	1.5	pF
$C_{PD}$	power dissipation capacitance	$C_L = 15\text{ pF}$ ; $f = 1\text{ MHz}$ ; notes 1 and 2	12	13	pF

## Notes

1.  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i + (C_L \times V_{CC}^2 \times f_o)$  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 Volts.
2. The condition is  $V_I = \text{GND to } V_{CC}$ .

## FUNCTION TABLE

See note 1.

INPUT (inA)	OUTPUT (outY)
L	H
H	L

## Note

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

## ORDERING INFORMATION

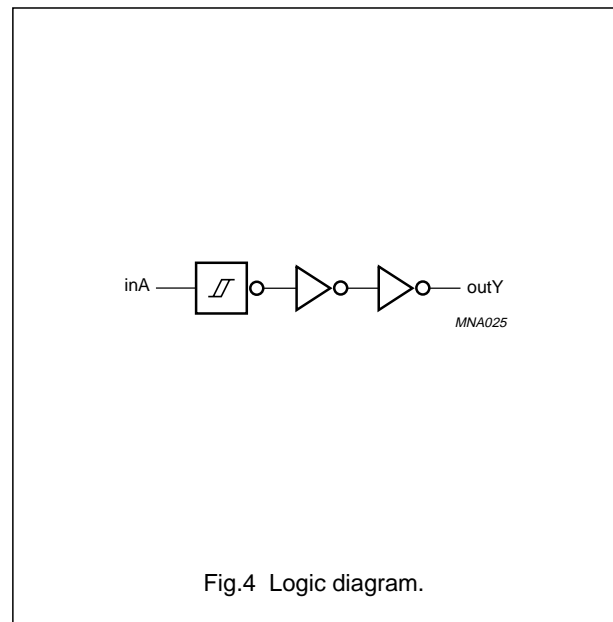
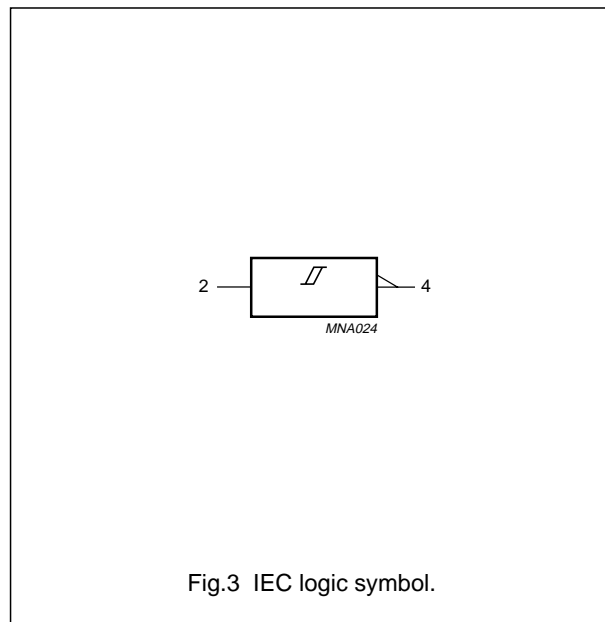
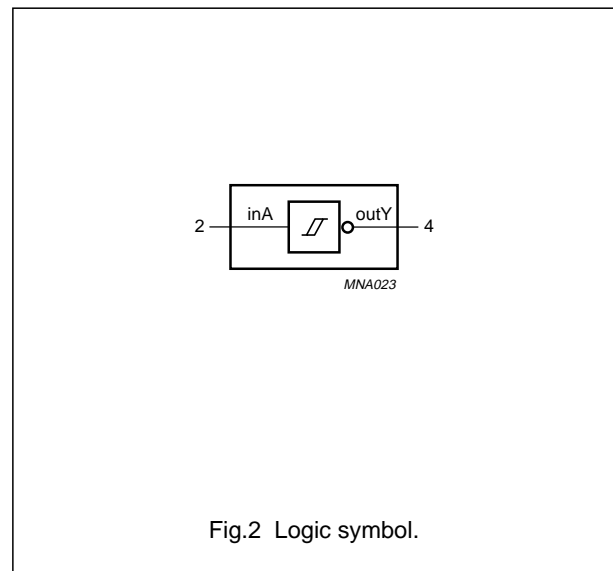
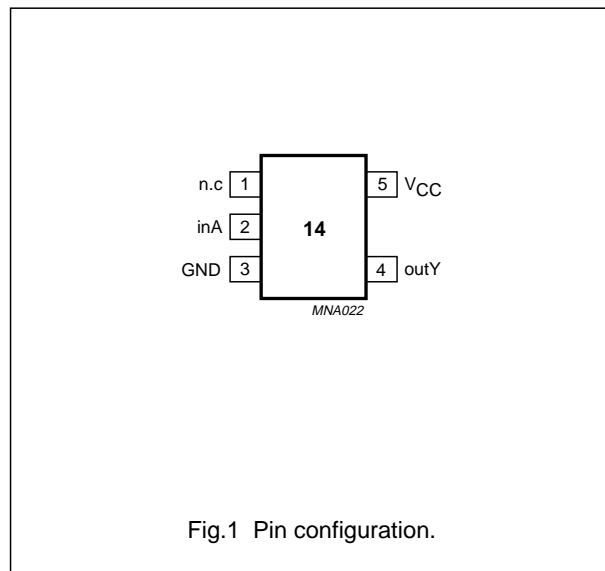
TYPE NUMBER	PACKAGES					
	TEMPERATURE RANGE	PINS	PACKAGE	MATERIAL	CODE	MARKING
74AHC1G14GW	-40 to +85 $^{\circ}\text{C}$	5	SC-88A	plastic	SOT353	AF
74AHCT1G14GW		5	SC-88A	plastic	SOT353	CF

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## PINNING

PIN	SYMBOL	DESCRIPTION
1	n.c.	not connected
2	inA	data input
3	GND	ground (0 V)
4	outY	data output
5	V <sub>CC</sub>	DC supply voltage



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## RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	74AHC1G			74AHCT1G			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
$V_{CC}$	DC supply voltage		2.0	5.0	5.5	4.5	5.0	5.5	V
$V_I$	input voltage		0	–	5.5	0	–	5.5	V
$V_O$	output voltage		0	–	$V_{CC}$	0	–	$V_{CC}$	V
$T_{amb}$	operating ambient temperature	see DC and AC characteristics per device	–40	+25	+85	–40	+25	+85	°C

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134); voltages are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CC}$	DC supply voltage		–0.5	+7.0	V
$V_I$	input voltage range		–0.5	+7.0	V
$I_{IK}$	DC input diode current	$V_I < -0.5$ V	–	–20	mA
$I_{OK}$	DC output diode current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V; note 1	–	±20	mA
$I_O$	DC output source or sink current	$-0.5$ V < $V_O$ < $V_{CC} + 0.5$ V	–	±25	mA
$I_{CC}$	DC $V_{CC}$ or GND current		–	±75	mA
$T_{stg}$	storage temperature		–65	+150	°C
$P_D$	power dissipation per package	temperature range: –40 to +85 °C; note 2	–	200	mW

## Notes

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. Above 55 °C the value of  $P_D$  derates linearly with 2.5 mW/K.

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## DC CHARACTERISTICS

## Family 74AHC1G

Over recommended operating conditions; voltage are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	TEST CONDITIONS		$T_{amb}$ (°C)					UNIT
		OTHER	$V_{CC}$ (V)	25			-40 to +85		
				MIN.	TYP.	MAX.	MIN.	MAX.	
$V_{OH}$	HIGH-level output voltage; all outputs	$V_I = V_{IH}$ or $V_{IL}$ ; $I_O = -50 \mu A$	2.0	1.9	2.0	–	1.9	–	V
			3.0	2.9	3.0	–	2.9	–	
			4.5	4.4	4.5	–	4.4	–	
	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$ ; $I_O = -4.0$ mA	3.0	2.58	–	–	2.48	–	V
4.5			3.94	–	–	3.8	–		
$V_{OL}$	LOW-level output voltage; all outputs	$V_I = V_{IH}$ or $V_{IL}$ ; $I_O = 50 \mu A$	2.0	–	0	0.1	–	0.1	V
			3.0	–	0	0.1	–	0.1	
			4.5	–	0	0.1	–	0.1	
	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$ ; $I_O = 4.0$ mA	3.0	–	–	0.36	–	0.44	V
4.5			–	–	0.36	–	0.44		
$I_I$	input leakage current	$V_I = V_{CC}$ or GND	5.5	–	–	0.1	–	1.0	$\mu A$
$I_{CC}$	quiescent supply current	$V_I = V_{CC}$ or GND; $I_O = 0$	5.5	–	–	1.0	–	10	$\mu A$
$C_I$	input capacitance			–	1.5	10	–	10	pF

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**Family 74AHCT1G**

Over recommended operating conditions; voltage are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	TEST CONDITIONS		T <sub>amb</sub> (°C)					UNIT
		OTHER	V <sub>CC</sub> (V)	25			-40 to +85		
				MIN.	TYP.	MAX.	MIN.	MAX.	
V <sub>OH</sub>	HIGH-level output voltage; all outputs	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -50 μA	4.5	4.4	4.5	–	4.4	–	V
	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -8.0 mA	4.5	3.94	–	–	3.8	–	V
V <sub>OL</sub>	LOW-level output voltage; all outputs	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 50 μA	4.5	–	0	0.1	–	0.1	V
	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 8.0 mA	4.5	–	–	0.36	–	0.44	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	5.5	–	–	0.1	–	1.0	μA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0	5.5	–	–	1.0	–	10	μA
ΔI <sub>CC</sub>	additional quiescent supply current per input pin	V <sub>I</sub> = 3.4 V; other inputs at V <sub>CC</sub> or GND; I <sub>O</sub> = 0	5.5	–	–	1.35	–	1.5	mA
C <sub>I</sub>	input capacitance			–	1.5	10	–	10	pF

## Inverting Schmitt trigger

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## TRANSFER CHARACTERISTICS

## Type 74AHC1G14

Over recommended operating conditions; voltage are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	TEST CONDITIONS		T <sub>amb</sub> (°C)					UNIT
		OTHER	V <sub>CC</sub> (V)	25			-40 to +85		
				MIN.	TYP.	MAX.	MIN.	MAX.	
V <sub>T+</sub>	positive-going threshold	see Figs 7 and 8	3.0	–	–	2.2	–	2.2	V
			4.5	–	–	3.15	–	3.15	
			5.5	–	–	3.85	–	3.85	
V <sub>T-</sub>	negative-going threshold	see Figs 7 and 8	3.0	0.9	–	–	0.9	–	V
			4.5	1.35	–	–	1.35	–	
			5.5	1.65	–	–	1.65	–	
V <sub>H</sub>	hysteresis (V <sub>T+</sub> – V <sub>T-</sub> )	see Figs 7 and 8	3.0	0.3	–	1.2	0.3	1.2	V
			4.5	0.4	–	1.4	0.4	1.4	
			5.5	0.5	–	1.6	0.5	1.6	

## Type 74AHCT1G14

Over recommended operating conditions; voltage are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	TEST CONDITIONS		T <sub>amb</sub> (°C)					UNIT
		WAVEFORMS	V <sub>CC</sub> (V)	25			-40 to +85		
				MIN.	TYP.	MAX.	MIN.	MAX.	
V <sub>T+</sub>	positive-going threshold	see Figs 7 and 8	4.5	–	–	2.0	–	2.0	V
			5.5	–	–	2.0	–	2.0	
V <sub>T-</sub>	negative-going threshold	see Figs 7 and 8	4.5	0.5	–	–	0.5	–	V
			5.5	0.6	–	–	0.6	–	
V <sub>H</sub>	hysteresis (V <sub>T+</sub> – V <sub>T-</sub> )	see Figs 7 and 8	4.5	0.4	–	1.4	0.4	1.4	V
			5.5	0.4	–	1.6	0.4	1.6	

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## AC CHARACTERISTICS

## Type 74AHC1G14

GND = 0 V;  $t_r = t_f \leq 3.0$  ns.

SYMBOL	PARAMETER	TEST CONDITIONS		T <sub>amb</sub> (°C)					UNIT
		WAVEFORMS	C <sub>L</sub>	25			-40 to +85		
				MIN.	TYP.	MAX.	MIN.	MAX.	
<b>V<sub>CC</sub> = 3.0 to 3.6V; note 1</b>									
t <sub>PHL</sub> /t <sub>PLH</sub>	propagation delay inA to outY	see Figs 5 and 6	15 pF	–	4.2	12.8	1.0	15.0	ns
			50 pF	–	6.0	16.3	1.0	18.5	ns
<b>V<sub>CC</sub> = 4.5 to 5.5 V; note 2</b>									
t <sub>PHL</sub> /t <sub>PLH</sub>	propagation delay inA to outY	see Figs 5 and 6	15 pF	–	3.2	8.6	1.0	10.0	ns
			50 pF	–	4.6	10.6	1.0	12.0	ns

## Notes

1. Typical values at V<sub>CC</sub> = 3.3 V.
2. Typical values at V<sub>CC</sub> = 5.0 V.

## Type 74AHCT1G14

GND = 0 V;  $t_r = t_f \leq 3.0$  ns.

SYMBOL	PARAMETER	TEST CONDITIONS		T <sub>amb</sub> (°C)					UNIT
		WAVEFORMS	C <sub>L</sub>	25			-40 to +85		
				MIN.	TYP.	MAX.	MIN.	MAX.	
<b>V<sub>CC</sub> = 4.5 to 5.5 V; note 1</b>									
t <sub>PHL</sub> /t <sub>PLH</sub>	propagation delay inA to outY	see Figs 5 and 6	15 pF	–	4.1	7.0	1.0	8.0	ns
			50 pF	–	5.9	8.5	1.0	10.0	ns

## Note

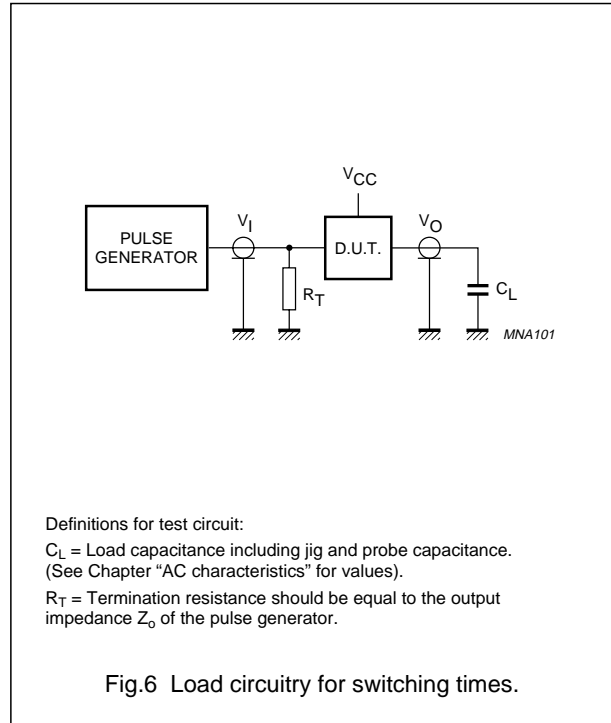
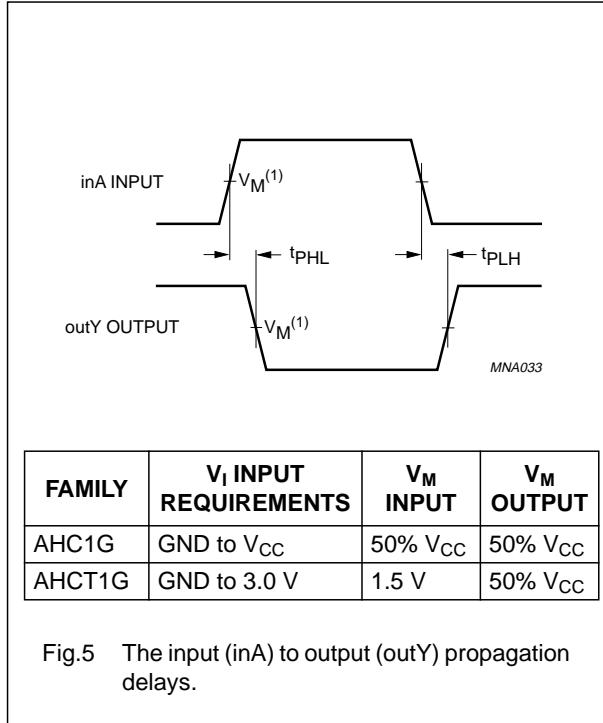
1. Typical values at V<sub>CC</sub> = 5.0 V.



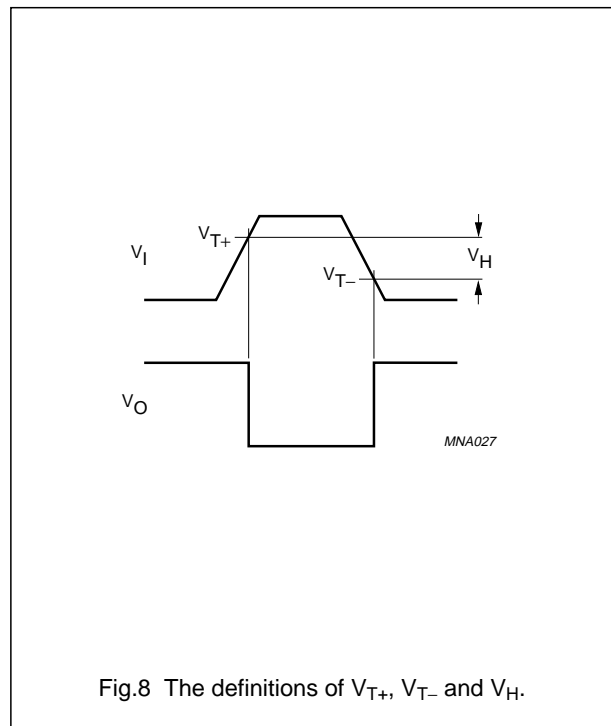
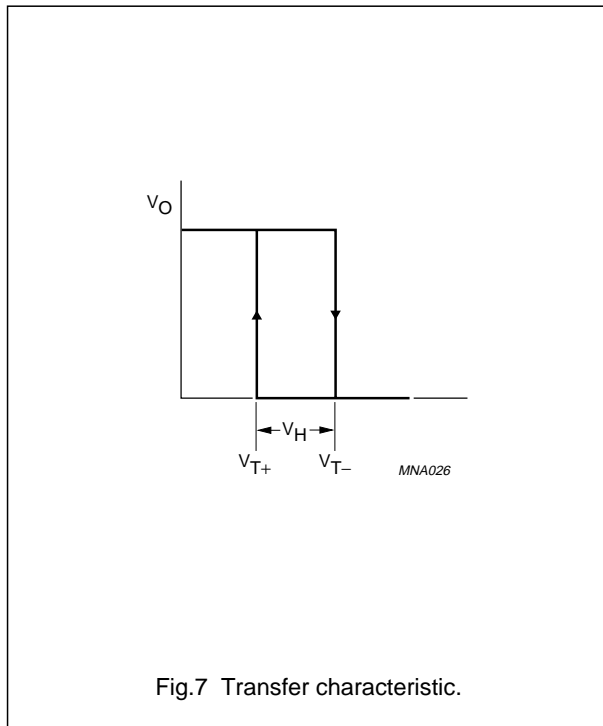
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## AC WAVEFORMS

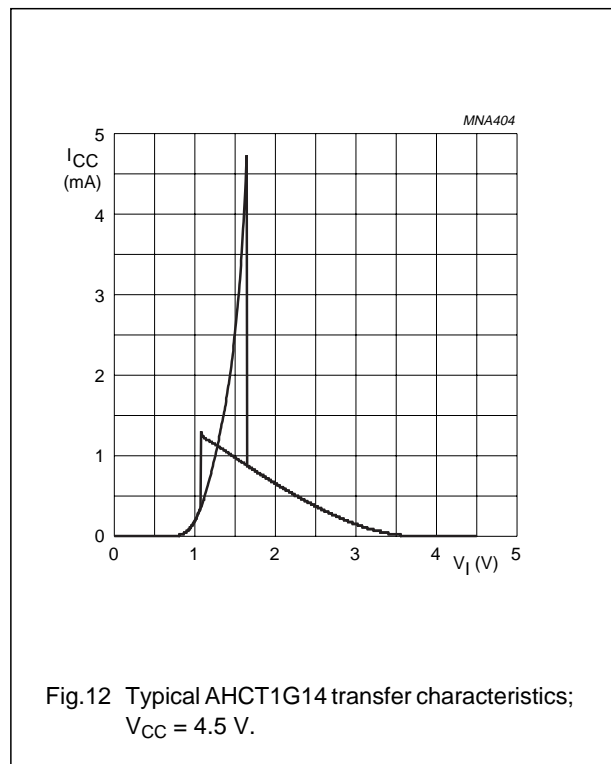
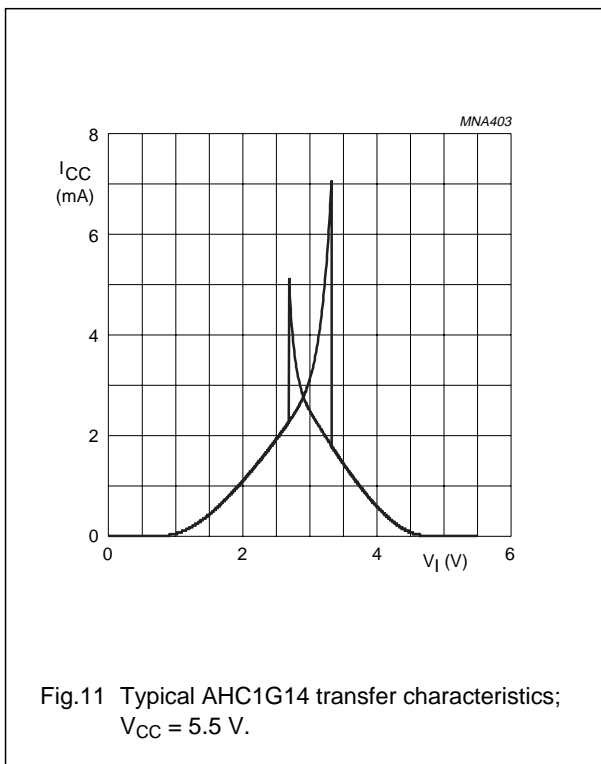
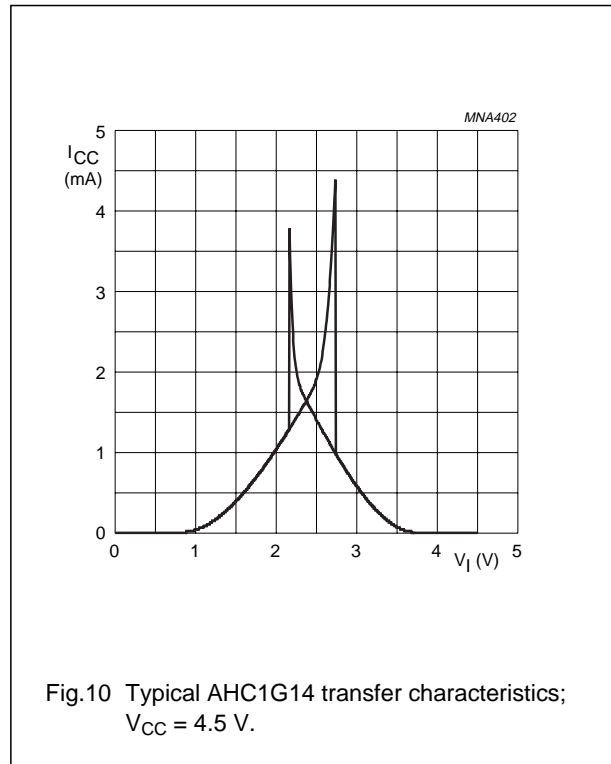
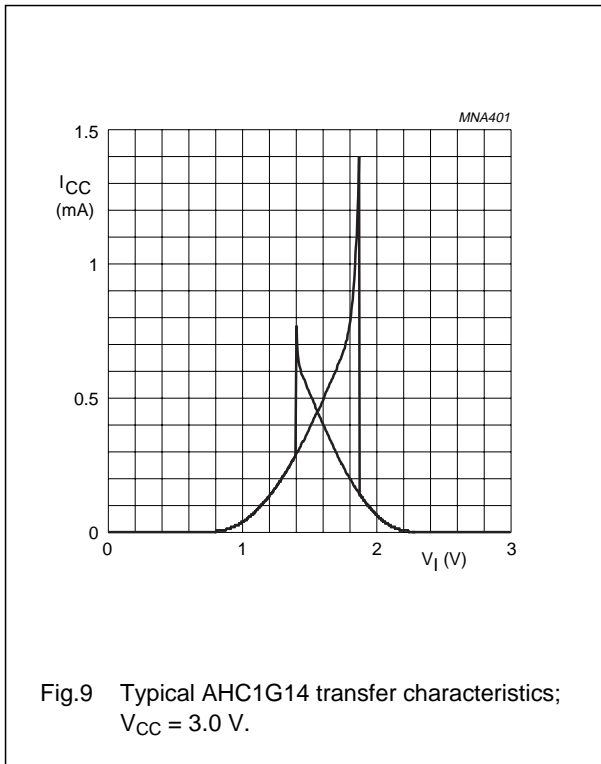


## TRANSFER CHARACTERISTIC WAVEFORMS



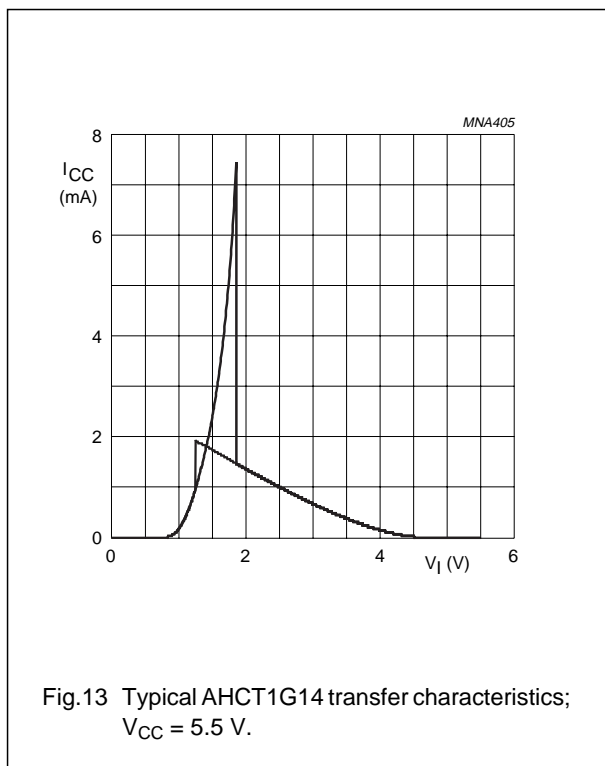
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# Inverting Schmitt trigger

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### APPLICATION INFORMATION

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

$$P_{ad} = f_i \times (t_r \times I_{CC(AV)} + t_f \times I_{CC(AV)}) \times V_{CC}$$

where:

$P_{ad}$  = additional power dissipation ( $\mu$ W);

$f_i$  = input frequency (MHz);

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

$t_f$  = input fall time (ns); 90% to 10%;

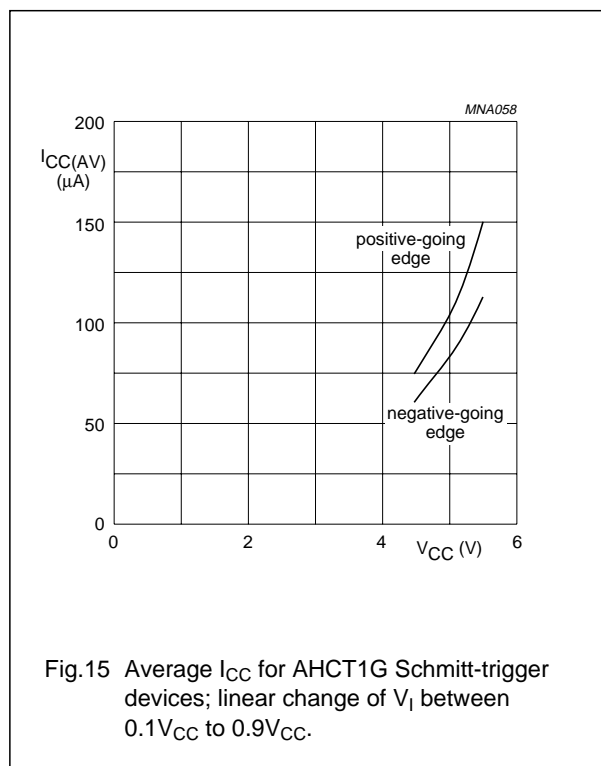
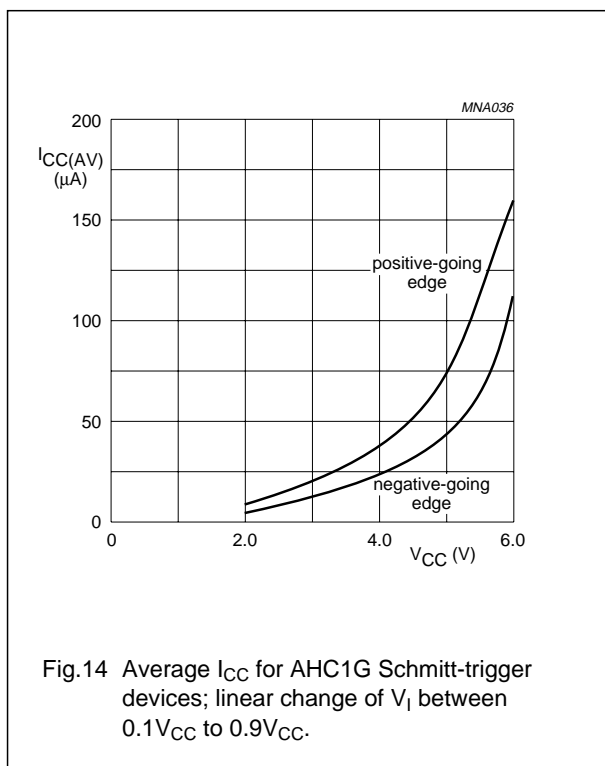
$I_{CC(AV)}$  = average additional supply current ( $\mu$ A).

Average  $I_{CC}$  differs with positive or negative input transitions, as shown in Figs 14 and 15.

AHC1G/AHCT1G14 used in relaxation oscillator circuit, see Fig.16.

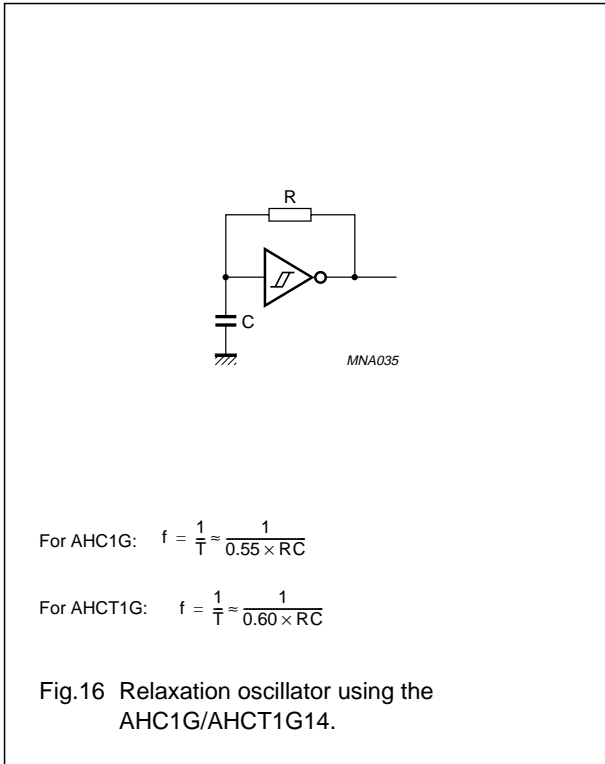
### Note to the application information:

1. All values given are typical unless otherwise specified.



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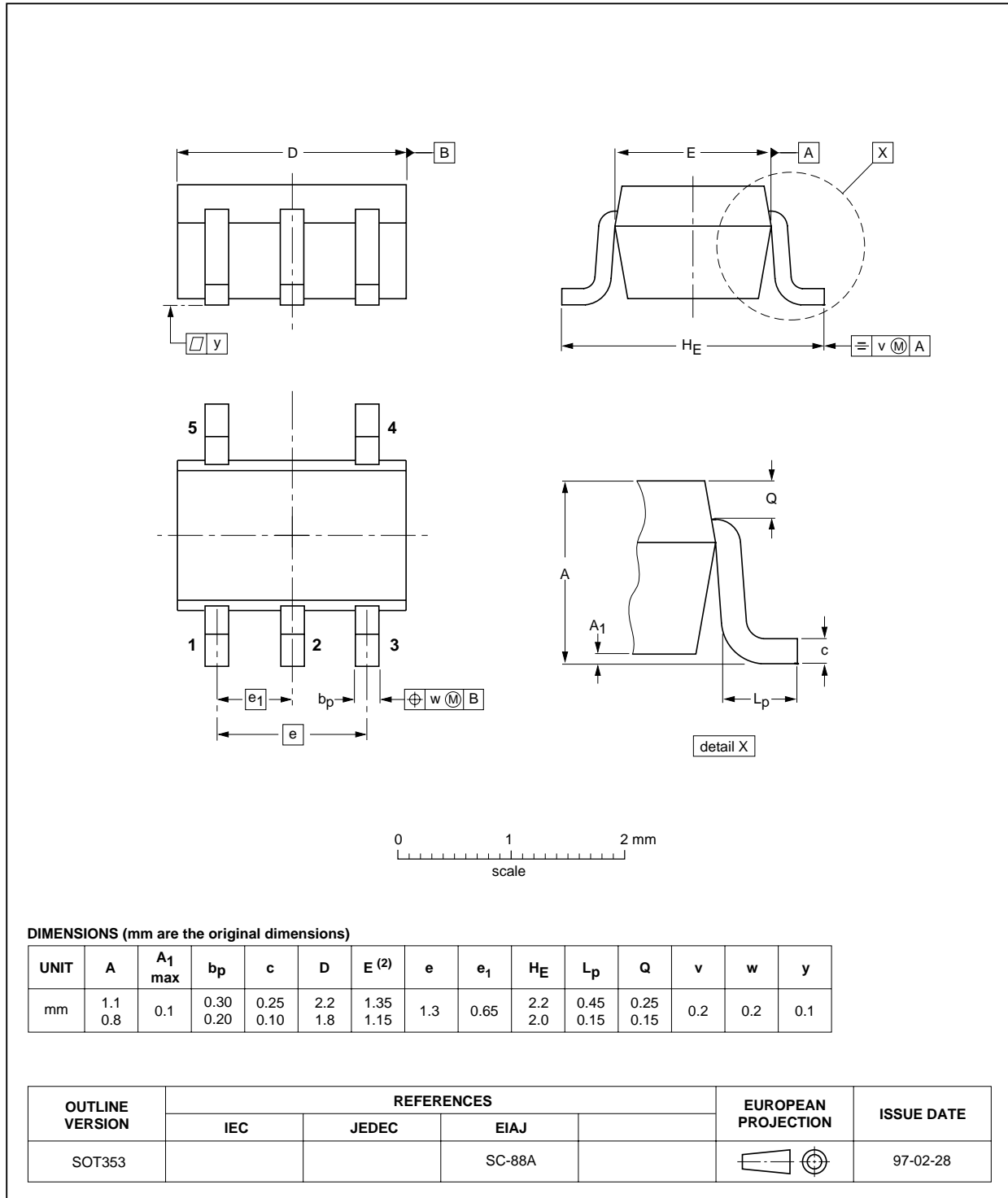
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## PACKAGE OUTLINE

Plastic surface mounted package; 5 leads

SOT353



## Inverting Schmitt trigger

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### SOLDERING

#### Introduction to soldering surface mount packages

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering is not always suitable for surface mount ICs, or for printed-circuit boards with high population densities. In these situations reflow soldering is often used.

#### Reflow soldering

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several methods exist for reflowing; for example, infrared/convection heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 250 °C. The top-surface temperature of the packages should preferably be kept below 230 °C.

#### Wave soldering

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
  - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
  - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

The footprint must incorporate solder thieves at the downstream end.

- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

#### Manual soldering

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C.

When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

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**Suitability of surface mount IC packages for wave and reflow soldering methods**

PACKAGE	SOLDERING METHOD	
	WAVE	REFLOW <sup>(1)</sup>
BGA, SQFP	not suitable	suitable
HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, SMS	not suitable <sup>(2)</sup>	suitable
PLCC <sup>(3)</sup> , SO, SOJ	suitable	suitable
LQFP, QFP, TQFP	not recommended <sup>(3)(4)</sup>	suitable
SSOP, TSSOP, VSO	not recommended <sup>(5)</sup>	suitable

**Notes**

1. All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the "Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods".
2. These packages are not suitable for wave soldering as a solder joint between the printed-circuit board and heatsink (at bottom version) can not be achieved, and as solder may stick to the heatsink (on top version).
3. If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
4. Wave soldering is only suitable for LQFP, TQFP and QFP packages with a pitch (e) equal to or larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
5. Wave soldering is only suitable for SSOP and TSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.

**DEFINITIONS**

<b>Data sheet status</b>	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
<b>Limiting values</b>	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	

**LIFE SUPPORT APPLICATIONS**

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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