HEX INVERTING SCHMITT TRIGGER

FEATURES

- **Output capability: standard**
- **I_{CC} category: SSI**

GENERAL DESCRIPTION

The 74HC/HCT14 are high-speed Si-gate CMOS devices and are pin compatible with low power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT14 provide six inverting buffers with Schmitt-trigger action. They are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL		UNIT
			HC	HCT	
t_{PHL}/ t_{PLH}	propagation delay nA to nY	C_L = 15 pF V_{CC} = 5 V	12	17	ns
C_I	input capacitance		3.5	3.5	pF
C_{PD}	power dissipation capacitance per gate	notes 1 and 2	7	8	pF

GND = 0 V; T_{amb} = 25 °C; $t_r = t_f$ = 6 ns

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW):
   $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma (C_L \times V_{CC}^2 \times f_o)$ where:
   f_i = input frequency in MHz
   f_o = output frequency in MHz
   $\Sigma (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs
   C_L = output load capacitance in pF
   V_{CC} = supply voltage in V
2. For HC the condition is V_I = GND to V_{CC}
   For HCT the condition is V_I = GND to V_{CC} − 1.5 V

PACKAGE OUTLINES

SEE PACKAGE INFORMATION SECTION

PIN DESCRIPTION

PIN NO.	SYMBOL	NAME AND FUNCTION
1, 3, 5, 9, 11, 13	1A to 6A	data inputs
2, 4, 6, 8, 10, 12	1Y to 6Y	data outputs
7	GND	ground (0 V)
14	V_{CC}	positive supply voltage

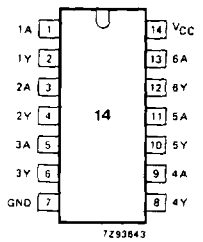

Fig. 1 Pin configuration.

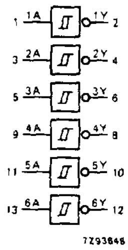

Fig. 2 Logic symbol.

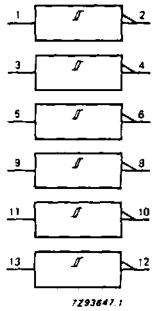

Fig. 3 IEC logic symbol.

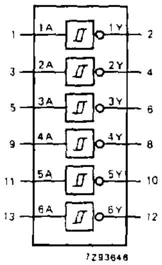

Fig. 4 Functional diagram.

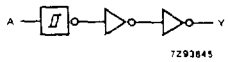

Fig. 5 Logic diagram (one Schmitt trigger).

FUNCTION TABLE

INPUT	OUTPUT
nA	nY
L H	H L

H = HIGH voltage level
L = LOW voltage level

APPLICATIONS

- Wave and pulse shapers
- Astable multivibrators
- Monostable multivibrators

DC CHARACTERISTICS FOR 74HC

For the DC characteristics see chapter "HCMOS family characteristics", section "Family specifications". Transfer characteristics are given below.

Output capability: standard
I_{CC} category: SSI

Transfer characteristics for 74HC

Voltages are referenced to GND (ground = 0 V)

SYMBOL	PARAMETER	T_{amb} (°C) 74HC +25			−40 to +85		−40 to +125		UNIT	TEST CONDITIONS V_{CC} V	WAVEFORMS
		min.	typ.	max.	min.	max.	min.	max.			
V_{T+}	positive-going threshold	0.7 1.7 2.1	1.18 2.38 3.14	1.5 3.15 4.2	0.7 1.7 2.1	1.5 3.15 4.2	0.7 1.7 2.1	1.5 3.15 4.2	V	2.0 4.5 6.0	Figs 6 and 7
V_{T-}	negative-going threshold	0.3 0.9 1.2	0.52 1.40 1.89	0.90 2.00 2.60	0.3 0.90 1.20	0.90 2.00 2.60	0.30 0.90 1.2	0.90 2.00 2.60	V	2.0 4.5 6.0	Figs 6 and 7
V_H	hysteresis ($V_{T+} - V_{T-}$)	0.2 0.4 0.6	0.66 0.98 1.25	1.0 1.4 1.6	0.2 0.4 0.6	1.0 1.4 1.6	0.2 0.4 0.6	1.0 1.4 1.6	V	2.0 4.5 6.0	Figs 6 and 7

AC CHARACTERISTICS FOR 74HC

GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF

SYMBOL	PARAMETER	T_{amb} (°C) 74HC +25			−40 to +85		−40 to +125		UNIT	TEST CONDITIONS V_{CC} V	WAVEFORMS
		min.	typ.	max.	min.	max.	min.	max.			
t_{PHL}/ t_{PLH}	propagation delay nA to nY		41 15 12	125 25 21		155 31 26		190 38 32	ns	2.0 4.5 6.0	Fig. 8
t_{THL}/ t_{TLH}	output transition time		19 7 6	75 15 13		95 19 16		110 22 19	ns	2.0 4.5 6.0	Fig. 8

DC CHARACTERISTICS FOR 74HCT

For the DC characteristics see chapter "HCMOS family characteristics", section "Family specifications". Transfer characteristics are given below.

Output capability: standard
I_{CC} category: SSI

Note to HCT types

The value of additional quiescent supply current (ΔI_{CC}) for a unit load of 1 is given in the family specifications. To determine ΔI_{CC} per input, multiply this value by the unit load coefficient shown in the table below.

INPUT	UNIT LOAD COEFFICIENT
nA	0.3

Transfer characteristics for 74HCT

Voltages are referenced to GND (ground = 0 V)

SYMBOL	PARAMETER	T_{amb} (°C) 74HCT +25 min.	typ.	max.	−40 to +85 min.	max.	−40 to +125 min.	max.	UNIT	TEST CONDITIONS V_{CC} V	WAVEFORMS
V_{T+}	positive-going threshold	1.2 1.4	1.41 1.59	1.9 2.1	1.2 1.4	1.9 2.1	1.2 1.4	1.9 2.1	V	4.5 5.5	Figs 6 and 7
V_{T-}	negative-going threshold	0.5 0.6	0.85 0.99	1.2 1.4	0.5 0.6	1.2 1.4	0.5 0.6	1.2 1.4	V	4.5 5.5	Figs 6 and 7
V_H	hysteresis ($V_{T+} - V_{T-}$)	0.4 0.4	0.56 0.60	− −	0.4 0.4	− −	0.4 0.4	− −	V	4.5 5.5	Figs 6 and 7

AC CHARACTERISTICS FOR 74HCT

GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF

SYMBOL	PARAMETER	T_{amb} (°C) 74HCT +25 min.	typ.	max.	−40 to +85 min.	max.	−40 to +125 min.	max.	UNIT	TEST CONDITIONS V_{CC} V	WAVEFORMS
t_{PHL}/ t_{PLH}	propagation delay nA to nY		20	34		43		51	ns	4.5	Fig. 8
t_{THL}/ t_{TLH}	output transition time		7	15		19		22	ns	4.5	Fig. 8

TRANSFER CHARACTERISTIC WAVEFORMS

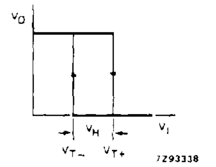

Fig. 6 Transfer characteristic.

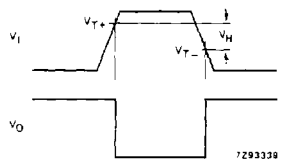

Fig. 7 Waveforms showing the definition of V_{T+}, V_{T-} and V_H; where V_{T+} and V_{T-} are between limits of 20% and 70%.

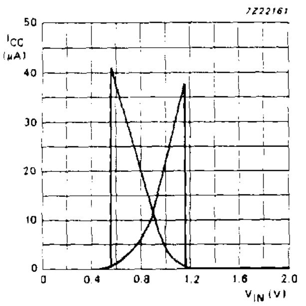

Fig. 8 Typical HC transfer characteristics; V_{CC} = 2 V.

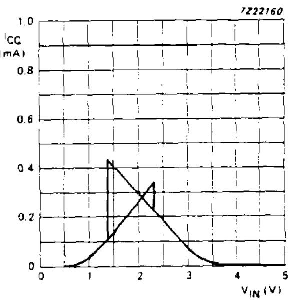

Fig. 9 Typical HC transfer characteristics; V_{CC} = 4.5 V.

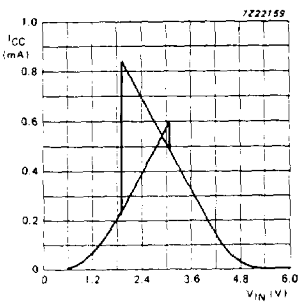

Fig. 10 Typical HC transfer characteristics; V_{CC} = 6 V.

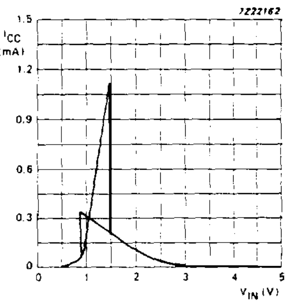

Fig. 11 Typical HCT transfer characteristics; V_{CC} = 4.5 V.

TRANSFER CHARACTERISTIC WAVEFORMS (Cont'd)

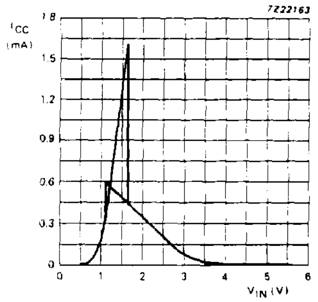

Fig. 12 Typical HCT transfer characteristics; V_{CC} = 5.5 V.

AC WAVEFORMS

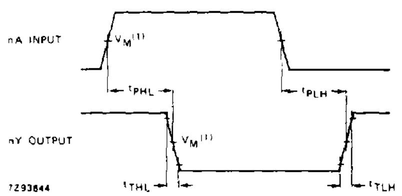

Fig. 13 Waveforms showing the input (nA) to output (nY) propagation delays and the output transition times.

Note to AC waveforms

(1) HC : V_M = 50%; V_I = GND to V_{CC}.
HCT: V_M = 1.3 V; V_I = GND to 3 V.

APPLICATION INFORMATION

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

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

Where:

P_{ad} = additional power dissipation (μW)
f_i = input frequency (MHz)
t_r = input rise time (μs); 10% – 90%
t_f = input fall time (μs); 10% – 90%
I_{CCa} = average additional supply current (μA)

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

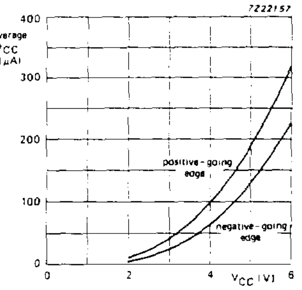

Fig. 14 Average I_{CC} for HC Schmitt trigger devices; linear change of V_i between 0.1 V_{CC} to 0.9 V_{CC}.

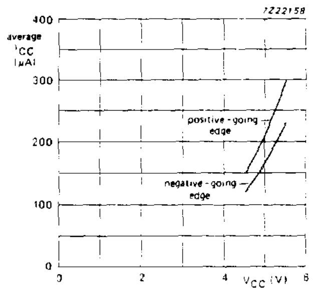

Fig. 15 Average I_{CC} for HCT Schmitt trigger devices; linear change of V_i between 0.1 V_{CC} to 0.9 V_{CC}.

HC/HCT14 used in a relaxation oscillator circuit, see Fig. 16.

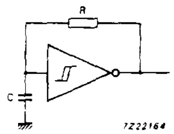

Fig. 16 Relaxation oscillator using HC/HCT14.

Note to Fig. 16

HC : $f = \frac{1}{T} \approx \frac{1}{0.8\,RC}$

HCT: $f = \frac{1}{T} \approx \frac{1}{0.67\,RC}$

Note to Application information

All values given are typical unless otherwise specified.