Hex inverting Schmitt trigger 74HC14; 74HCT14

FEATURES

- Applications:
  - Wave and pulse shapers
  - Astable multivibrators
  - Monostable multivibrators.
- Complies with JEDEC standard no. 7A
- ESD protection:
  HBM EIA/JESD22-A114-A exceeds 2000 V
  MM EIA/JESD22-A115-A exceeds 200 V.
- Specified from –40 to +85 °C and –40 to +125 °C.

DESCRIPTION

The 74HC14 and 74HCT14 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 74HC14 and 74HCT14 provide six inverting buffers with Schmitt-trigger action. They are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

QUICK REFERENCE DATA

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

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

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW):
   $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ 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 Volts;
   N = total load switching outputs;
   $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.
2. For type 74HC14 the condition is V_I = GND to V_{CC}.
   For type 74HCT14 the condition is V_I = GND to V_{CC} – 1.5 V.

FUNCTION TABLE

INPUT	OUTPUT
nA	**nY**
L	H
H	L

Note

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

ORDERING INFORMATION

TYPE NUMBER	PACKAGE				
	TEMPERATURE RANGE	PINS	PACKAGE	MATERIAL	CODE
74HC14D	–40 to +125 °C	14	SO14	plastic	SOT108-1
74HCT14D	–40 to +125 °C	14	SO14	plastic	SOT108-1
74HC14DB	–40 to +125 °C	14	SSOP14	plastic	SOT337-1
74HCT14DB	–40 to +125 °C	14	SSOP14	plastic	SOT337-1
74HC14N	–40 to +125 °C	14	DIP14	plastic	SOT27-1
74HCT14N	–40 to +125 °C	14	DIP14	plastic	SOT27-1
74HC14PW	–40 to +125 °C	14	TSSOP14	plastic	SOT402-1
74HCT14PW	–40 to +125 °C	14	TSSOP14	plastic	SOT402-1
74HC14BQ	–40 to +125 °C	14	DHVQFN14	plastic	SOT762-1
74HCT14BQ	–40 to +125 °C	14	DHVQFN14	plastic	SOT762-1

PINNING

PIN	SYMBOL	DESCRIPTION
1	1A	data input
2	1Y	data output
3	2A	data input
4	2Y	data output
5	3A	data input
6	3Y	data output
7	GND	ground (0 V)
8	4Y	data output
9	4A	data input
10	5Y	data output
11	5A	data input
12	6Y	data output
13	6A	data input
14	V_{CC}	supply voltage

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	74HC14			74HCT14			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
V_{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V_I	input voltage		0	–	V_{CC}	0	–	V_{CC}	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
			–40	–	+125	–40	–	+125	°C

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 60134); voltages are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	supply voltage		–0.5	+7	V
I_{IK}	input diode current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	–	±20	mA
I_{OK}	output diode current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V	–	±20	mA
I_O	output source or sink current	-0.5 V $< V_O < V_{CC} + 0.5$ V	–	±25	mA
I_{CC}; I_{GND}	V_{CC} or GND current		–	50	mA
T_{stg}	storage temperature		–65	+150	°C
P_{tot}	power dissipation	T_{amb} = –40 to +125 °C			
		DIP14 packages; note 1	–	750	mW
		Other packages; note 2	–	500	mW

Notes

1. For DIP14 packages: above 70 °C the value of P_D derates linearly with 12 mW/K.
2. For SO14 packages: above 70 °C the value of P_D derates linearly with 8 mW/K.
   For (T)SSOP14 packages: above 60 °C the value of P_D derates linearly with 5.5 mW/K.
   For DHVQFN14 packages: above 60 °C the value of P_D derates linearly with 4.5 mW/K.

Type 74HCT14

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.(1)	MAX.	UNIT
		OTHER	V_{CC} (V)				
T_{amb} = 25 °C							
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}					
		I_O = –20 μA	4.5	4.4	4.5	–	V
		I_O = –4.0 mA	4.5	3.98	4.32	–	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}					
		I_O = 20 μA	4.5	–	0	0.1	V
		I_O = 4.0 mA	4.5	–	0.15	0.26	V
I_{LI}	input leakage current	$V_I = V_{CC}$ or GND	5.5	–	–	0.1	μA
I_{CC}	quiescent supply current	$V_I = V_{CC}$ or GND; I_O = 0	5.5	–	–	2.0	μA
ΔI_{CC}	additional supply current per input	$V_I = V_{CC}$ – 2.1 V; I_O = 0	4.5 to 5.5	–	30	108	μA
T_{amb} = –40 to +85 °C							
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}					
		I_O = –20 μA	4.5	4.4	–	–	V
		I_O = –4.0 mA	4.5	3.84	–	–	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}					
		I_O = 20 μA	4.5	–	–	0.1	V
		I_O = 4.0 mA	4.5	–	–	0.33	V
I_{LI}	input leakage current	$V_I = V_{CC}$ or GND	5.5	–	–	1.0	μA
I_{CC}	quiescent supply current	$V_I = V_{CC}$ or GND; I_O = 0	5.5	–	–	20	μA
ΔI_{CC}	additional supply current per input	$V_I = V_{CC}$ – 2.1 V; I_O = 0	4.5 to 5.5	–	–	135	μA
T_{amb} = –40 to +125 °C							
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}					
		I_O = –20 μA	4.5	4.4	–	–	V
		I_O = –4.0 mA	4.5	3.7	–	–	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}					
		I_O = 20 μA	4.5	–	–	0.1	V
		I_O = 4.0 mA	4.5	–	–	0.4	V
I_{LI}	input leakage current	$V_I = V_{CC}$ or GND	5.5	–	–	1.0	μA
I_{CC}	quiescent supply current	$V_I = V_{CC}$ or GND; I_O = 0	5.5	–	–	40	μA
ΔI_{CC}	additional supply current per input	$V_I = V_{CC}$ – 2.1 V; I_O = 0	4.5 to 5.5	–	–	147	μA

Note

1. All typical values are measured at T_{amb} = 25 °C.

Family 74HCT

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		WAVEFORMS	V_{CC} (V)				
T_{amb} = 25 °C; note 1							
V_{T+}	positive-going threshold	Figs 7 and 8	4.5	1.2	1.41	1.9	V
			5.5	1.4	1.59	2.1	V
V_{T-}	negative-going threshold	Figs 7 and 8	4.5	0.5	0.85	1.2	V
			5.5	0.6	0.99	1.4	V
V_H	hysteresis ($V_{T+} - V_{T-}$)	Figs 7 and 8	4.5	0.4	0.56	–	V
			5.5	0.4	0.60	–	V
T_{amb} = −40 to +85 °C							
V_{T+}	positive-going threshold	Figs 7 and 8	4.5	1.2	–	1.9	V
			5.5	1.4	–	2.1	V
V_{T-}	negative-going threshold	Figs 7 and 8	4.5	0.5	–	1.2	V
			5.5	0.6	–	1.4	V
V_H	hysteresis ($V_{T+} - V_{T-}$)	Figs 7 and 8	4.5	0.4	–	–	V
			5.5	0.4	–	–	V
T_{amb} = −40 to +125 °C							
V_{T+}	positive-going threshold	Figs 7 and 8	4.5	1.2	–	1.9	V
			5.5	1.4	–	2.1	V
V_{T-}	negative-going threshold	Figs 7 and 8	4.5	0.5	–	1.2	V
			5.5	0.6	–	1.4	V
V_H	hysteresis ($V_{T+} - V_{T-}$)	Figs 7 and 8	4.5	0.4	–	–	V
			5.5	0.4	–	–	V

Note

1. All typical values are measured at T_{amb} = 25 °C.

Type 74HCT

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		WAVEFORMS	V_{CC} (V)				
T_{amb} = 25 °C; note 1							
t_{PHL}/t_{PLH}	propagation delay nA to nY	see Fig.9	4.5	–	20	34	ns
t_{THL}/t_{TLH}	output transition time	see Fig.9	4.5	–	7	15	ns
T_{amb} = −40 to +85 °C							
t_{PHL}/t_{PLH}	propagation delay nA to nY	see Fig.9	4.5	43	–	–	ns
t_{THL}/t_{TLH}	output transition time	see Fig.9	4.5	19	–	–	ns
T_{amb} = −40 to +125 °C							
t_{PHL}/t_{PLH}	propagation delay nA to nY	see Fig.9	4.5	–	–	51	ns
t_{THL}/t_{TLH}	output transition time	see Fig.9	4.5	–	–	22	ns

Note

1. All typical values are measured at T_{amb} = 25 °C.

TRANSFER CHARACTERISTIC WAVEFORMS

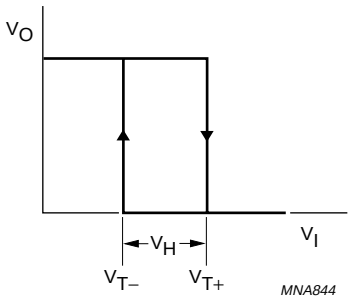
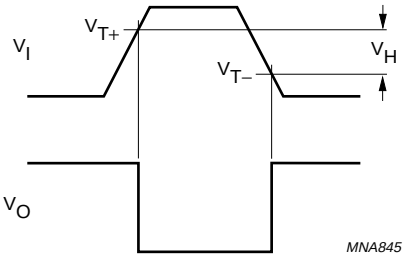


Fig.7 Transfer characteristic.

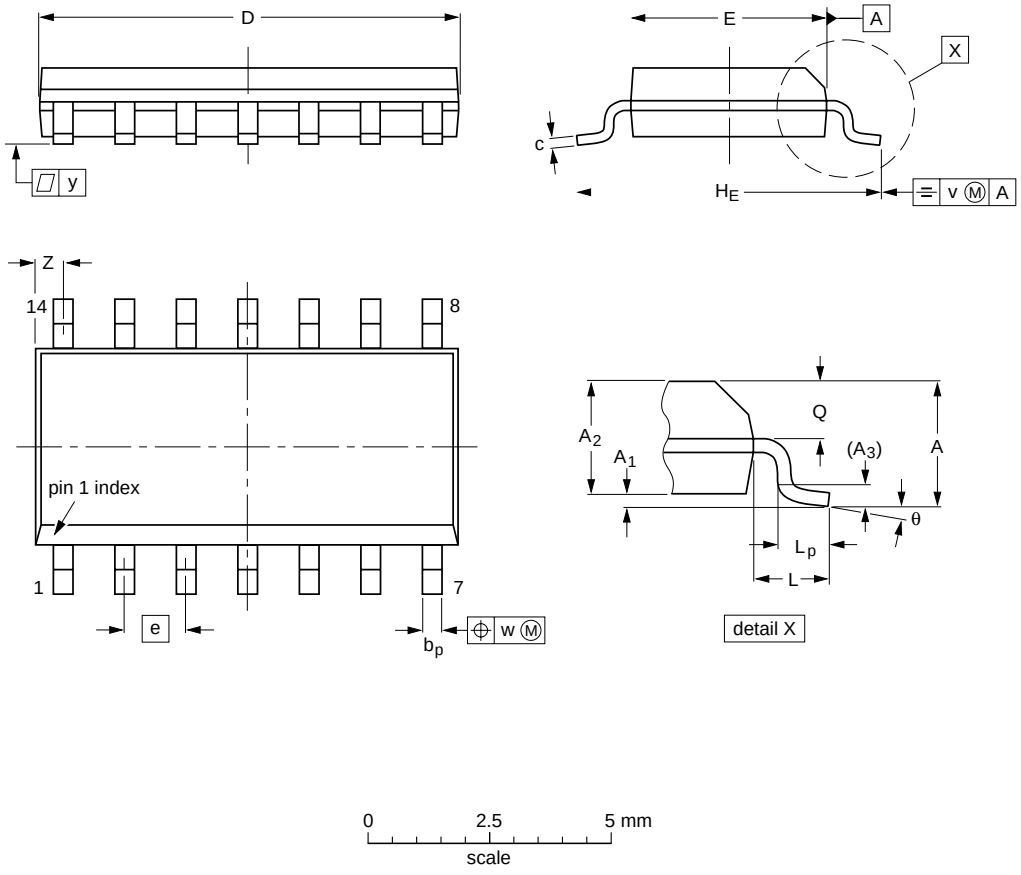


V_{T+} and V_{T-} are between limits of 20% and 70%.

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

PACKAGE OUTLINES

SO14: plastic small outline package; 14 leads; body width 3.9 mm **SOT108-1**



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

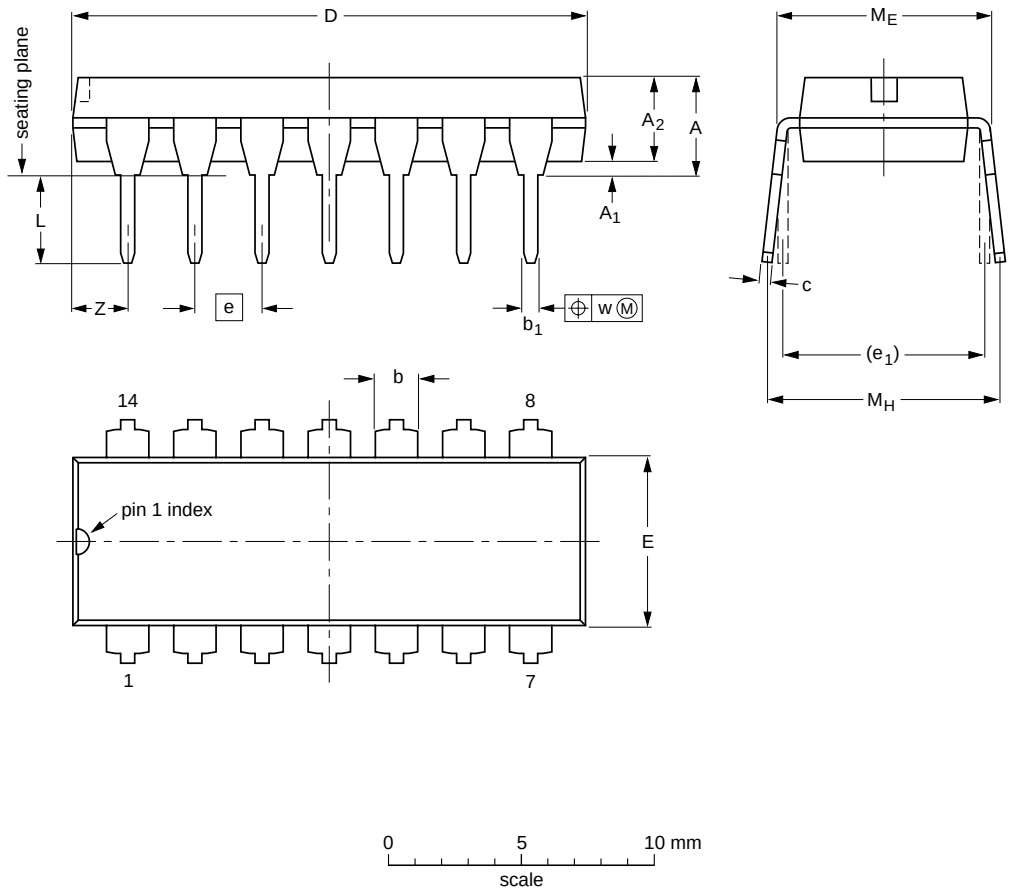
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8^o 0^o
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.35 0.34	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	
	IEC	JEDEC	JEITA			
SOT108-1	076E06	MS-012				

DIP14: plastic dual in-line package; 14 leads (300 mil) **SOT27-1**



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

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.13	0.53 0.38	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.2
inches	0.17	0.02	0.13	0.068 0.044	0.021 0.015	0.014 0.009	0.77 0.73	0.26 0.24	0.1	0.3	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	
	IEC	JEDEC	JEITA			
SOT27-1	050G04	MO-001	SC-501-14			