74HC7014

Hex non-inverting precision Schmitt-trigger

Rev. 6 — 2 April 2024 Product data sheet

1. General description

The 74HC7014 is a hex buffer with precision Schmitt-trigger inputs. The precisely defined trigger levels are lying in a window between 0.55 × V_{CC} and 0.65 × V_{CC}. It makes the circuit suitable to operate in a highly noisy environment. Input shorts are allowed to -1.5 V and +16 V without disturbing other channels. 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.

2. Features and benefits

- Wide supply voltage from 2.0 V to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Unlimted input rise and fall times
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Complies with JEDEC standard no. 7A
- ESD protection:
  - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
  - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Applications

- Wave and pulse shapers for highly noisy environments

4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC7014D	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1

5. Functional diagram

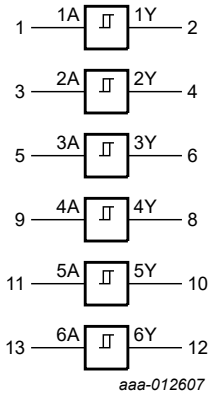

Fig. 1. Logic symbol

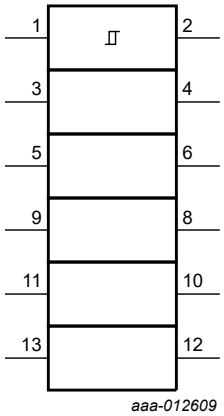

Fig. 2. IEC logic symbol

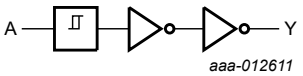

Fig. 3. Logic diagram (one gate)

6. Pinning information

6.1. Pinning

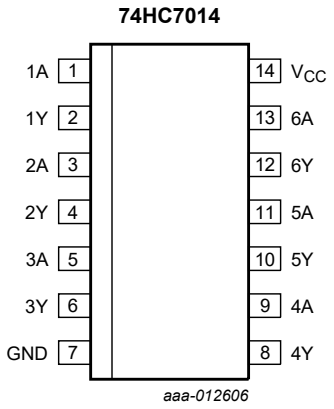

Fig. 4. Pin configuration (SOT108-1) SO14

6.2. Pin description

Table 2. Pin description

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

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7. Functional description

Table 3. Functional table

H = HIGH voltage level; L = LOW voltage level

Input	Output
nA	**nY**
L	L
H	H

8. 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_{CC}	supply voltage			-0.5	+7	V
I_{IK}	input clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	[1]	-	±20	mA
I_{OK}	output clamping current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V	[1]	-	±20	mA
I_O	output current	-0.5 V $< V_O < V_{CC} + 0.5$ V		-	25	mA
I_{CC}	supply current			-	50	mA
I_{GND}	ground current			-50	-	mA
T_{stg}	storage temperature			-65	+150	°C
P_{tot}	total power dissipation	SO14 package	[2]	-	500	mW

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2] For SOT108-1 (SO14) package: P_{tot} derates linearly with 10.1 mW/K above 100 °C.

9. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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	-	+125	°C

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10. Static characteristics

Table 6. Static characteristics

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

Symbol	Parameter	Conditions	T_{amb} = 25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
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	-	1.9	-	1.9	-	V
		I_O = -20 µA; V_{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I_O = -20 µA; V_{CC} = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I_O = -4.0 mA; V_{CC} = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I_O = -5.2 mA; V_{CC} = 6.0 V	5.48	5.81	-	5.34	-	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	0.1	-	0.1	-	0.1	V
		I_O = 20 µA; V_{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 20 µA; V_{CC} = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 4.0 mA; V_{CC} = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I_O = 5.2 mA; V_{CC} = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I_I	input leakage current	V_{CC} = 6.00 V; V_I = V_{CC} or GND	-	-	0.1	1.0	-	1.0	-	µA
		V_{CC} = 3.00 V to 6.00 V; V_I = 16 V or GND	-	-	0.5	5.0	-	5.0	-	µA
I_{CC}	DC supply current	V_{CC} = 3.00 V	-	0.7	1.4	-	1.8	-	2.1	mA
		V_{CC} = 5.25 V	-	3.0	6.0	-	7.5	-	7.5	mA
		V_{CC} = 6.00 V	-	3.7	7.4	-	10.0	-	13.0	mA
C_I	input capacitance		-	3.5	-	-	-	-	-	pF

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11. Dynamic characteristics

Table 7. Dynamic characteristics

GND = 0 V; for test circuit, see Fig. 6.

Symbol	Parameter	Conditions	T_{amb} = 25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t_{PHL}	HIGH to LOW propagation delay	nA to nY; see Fig. 5								
		V_{CC} = 3.00 V	-	95	475	-	600	-	715	ns
		V_{CC} = 4.75 V	-	38	115	-	145	-	175	ns
		V_{CC} = 6.00 V	-	27	73	-	93	-	112	ns
t_{PLH}	LOW to HIGH propagation delay	nA to nY; see Fig. 5								
		V_{CC} = 3.00 V	-	47	175	-	220	-	260	ns
		V_{CC} = 4.75 V	-	23	52	-	65	-	78	ns
		V_{CC} = 6.00 V	-	18	46	-	58	-	70	ns
t_t	transition time	see Fig. 5 [1]								
		V_{CC} = 3.00 V	-	12	20	-	25	-	30	ns
		V_{CC} = 4.75 V	-	7	15	-	19	-	22	ns
		V_{CC} = 6.00 V	-	6	13	-	16	-	19	ns
C_{PD}	power dissipation capacitance	per gate; V_I = GND to V_{CC} [2]	-	9	-	-	-	-	-	pF

[1] t_t is the same as t_{THL} and t_{TLH}.

[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;
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

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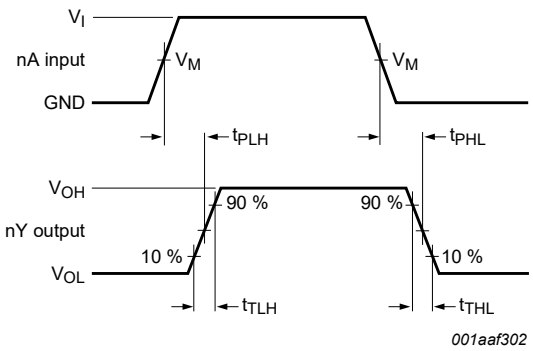
11.1. Waveforms and test circuit



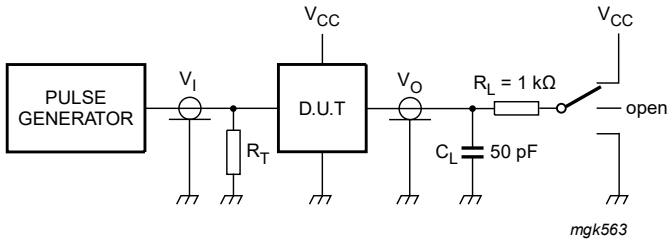
Measurement points are given in Table 8.

V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig. 5. Input (nA) to output (nY) propagation delays and output transition times

Table 8. Measurement points

Type	Input	Output
	V_M	V_M
74HC7014	0.5 × V_{CC}	0.5 × V_{CC}



Test data is given in Table 9.

Definitions test circuit:

R_L = Load resistance;

C_L = Load capacitance including jig and probe capacitance;

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

Fig. 6. Test circuit for measuring switching times

Table 9. Test data

Type	Input		Test
	V_I	t_r, t_f	t_{PHL}, t_{PLH}
74HC7014	GND to V_{CC}	6 ns	open

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12. Transfer characteristics

Table 10. Transfer characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see Fig. 7 and Fig. 8.

Symbol	Parameter	Conditions	T_{amb} = 25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
V_{T+}	positive-going threshold voltage	V_{CC} = 3.00 V	-	1.86	1.95	-	1.95	-	1.95	V
		V_{CC} = 4.75 V	-	2.94	3.08	-	3.08	-	3.08	V
		V_{CC} = 5.00 V	-	3.10	3.25	-	3.25	-	3.25	V
		V_{CC} = 5.25 V	-	3.25	3.41	-	3.41	-	3.41	V
		V_{CC} = 6.00 V	-	3.72	3.90	-	3.90	-	3.90	V
V_{T-}	negative-going threshold voltage	V_{CC} = 3.00 V	1.65	1.74	-	1.65	-	1.65	-	V
		V_{CC} = 4.75 V	2.62	2.76	-	2.62	-	2.62	-	V
		V_{CC} = 5.00 V	2.75	2.90	-	2.75	-	2.75	-	V
		V_{CC} = 5.25 V	2.89	3.05	-	2.89	-	2.89	-	V
		V_{CC} = 6.00 V	3.30	3.48	-	3.30	-	3.30	-	V
V_H	hysteresis voltage	V_{CC} = 3.00 V	50	120	-	50	-	50	-	mV
		V_{CC} = 4.75 V	100	180	-	100	-	100	-	mV
		V_{CC} = 5.00 V	120	200	-	120	-	120	-	mV
		V_{CC} = 5.25 V	130	210	-	130	-	130	-	mV
		V_{CC} = 6.00 V	160	240	-	160	-	160	-	mV

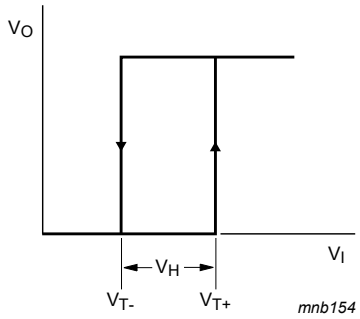
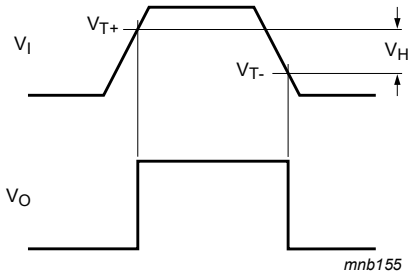


Fig. 7. Transfer characteristic



V_{T+} and V_{T-} limits at 70 % and 20 %.

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

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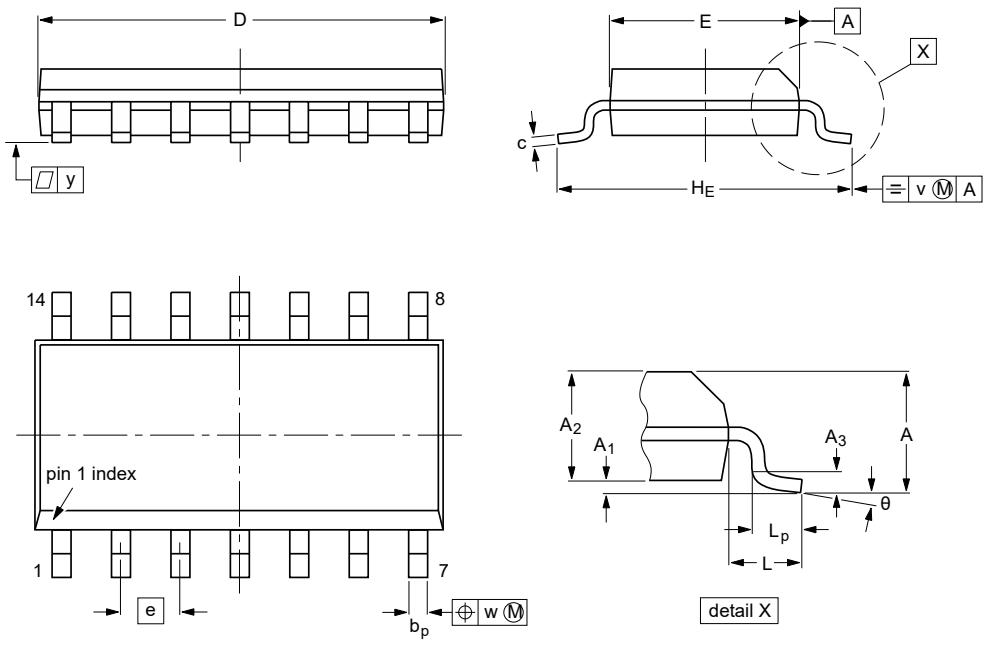
13. Package outline

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	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	v	w	y	θ
mm	max	1.75	0.25			0.51	0.25	8.75	4.0		6.2		1.27				8°
	nom				0.25					1.27		1.05		0.2	0.25	0.1	
	min		0.10	1.25		0.31	0.10	8.55	3.8		5.8		0.4				0°
inches	max	0.069	0.010			0.020	0.010	0.344	0.16		0.244		0.05				8°
	nom				0.01					0.05		0.041		0.008	0.01	0.004	
	min		0.004	0.049		0.012	0.004	0.337	0.15		0.228		0.016				0°

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

sot108-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT108-1		MS-012				~~03-02-19~~ 23-10-27

Fig. 9. Package outline SOT108-1 (SO14)

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14. Abbreviations

Table 11. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model

15. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC7014 v.6	20240402	Product data sheet	-	74HC7014 v.5
Modifications:	• Fig. 9: Aligned SO package outline drawing to JEDEC MS-012. • Section 2: ESD specification updated according to the latest JEDEC standard.			
74HC7014 v.5	20220707	Product data sheet	-	74HC7014 v.4
Modifications:	• The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. • Legal texts have been adapted to the new company name where appropriate. • Section 2 updated. • Table 4: Derating values for P_{tot} total power dissipation updated. • Table 7: Values added for $T_{PHL(max)}$ at T_{amb} = -40 °C to +85 °C. (errata) • Table 10: Unit of hysteresis voltage changed to millivolts. (errata)			
74HC7014 v.4	20151126	Product data sheet	-	74HC7014 v.3
Modifications:	• Type number 74HC7014N (SOT27-1) removed.			
74HC7014 v.3	20140430	Product data sheet	-	74HC7014_CVN v.2
Modifications:	• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate.			
74HC7014_CVN v.2	19980708	Product specification	-	74HC7014 v.1
74HC7014 v.1	19930901	Product specification	-	-

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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.

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