74AHCV05A

Hex inverter Schmitt trigger with open-drain outputs

Rev. 1 — 24 June 2019 Product data sheet

1. General description

The 74AHCV05A is a hex inverter with Schmitt trigger inputs and open-drain outputs. The outputs are open-drain and can be connected to other open-drain outputs to implement active-LOW wired-OR or active-HIGH wired-AND functions.

Inputs are overvoltage tolerant. This feature allows the use of these devices as translators in mixed voltage environments.

The data (nA) inputs include Schmitt trigger inputs capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

This device is fully specified for partial power down applications using I_{OFF}. The I_{OFF} circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down.

2. Features and benefits

- Wide supply voltage range from 1.8 V to 5.5 V
- Typical t_{PZL} of 3.6 ns at 5 V
- Typical $V_{OL(p)}$ < 0.8 V at V_{CC} = 3.3 V, T_{amb} = 25 °C
- Supports mixed-mode voltage operation on all ports
- I_{OFF} circuitry provides partial Power-down mode operation
- Latch-up performance exceeds 250 mA per JESD 78 Class II
- ESD protection:
  - HBM: ANSI/ESDA/JEDEC JS-001 Class 2 exceeds 3 kV
  - MM: JESD22-A115-A exceeds 150 V
  - CDM: ANSI/ESDA/JEDEC JS-002 Class C3, exceeds 2 kV
- 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
74AHCV05APW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1

4. Functional diagram

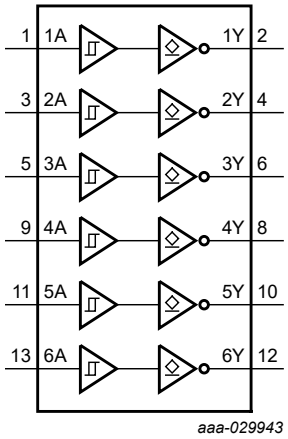


Fig. 1. Logic symbol

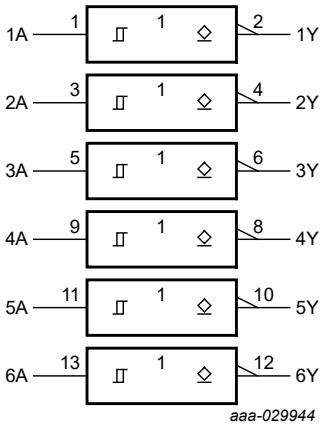


Fig. 2. IEC logic symbol

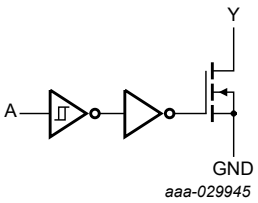


Fig. 3. Logic diagram (one gate)

5. Pinning information

5.1. Pinning

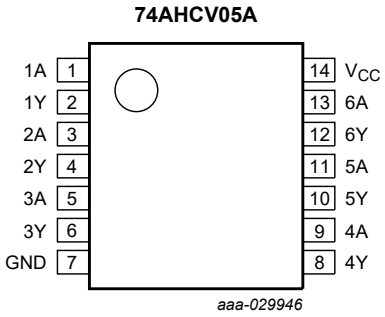


Fig. 4. Pin configuration TSSOP14 (SOT402-1)

5.2. 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, 3Y, 4Y, 5Y, 6Y	2, 4, 6, 8, 10, 12	data output
GND	7	ground (0 V)
V_{CC}	14	supply voltage

6. Functional description

Table 3. Function selection

H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state

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

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_{CC}	supply voltage		-0.5	+7.0	V
V_I	input voltage	[1]	-0.5	+7.0	V
V_O	output voltage	output LOW state, 3-state or power-down [2]	-0.5	+7.0	V
I_{IK}	input clamping current	V_I < 0 V	-50	-	mA
I_{OK}	output clamping current	V_O < 0 V	-50	-	mA
I_O	output current	V_O = 0 V to V_{CC}	-	±50	mA
I_{CC}	supply current		-	100	mA
I_{GND}	ground current		-100	-	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	T_{amb} = -40 °C to +125 °C [3]	-	500	mW

[1] The minimum input voltage ratings may be exceeded if the input current ratings are observed.
[2] The output voltage ratings may be exceeded if the output current ratings are observed.
[3] For TSSOP14 packages: above 75 °C the value of P_{tot} derates linearly at 7 mW/K.

8. 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		1.8	5.0	5.5	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage	output LOW state, 3-state or power-down	0	-	5.5	V
T_{amb}	ambient temperature		-40	+25	+125	°C
Δt/ΔV	input transition rise and fall rate	V_{CC} = 2.3 V to 2.7 V	-	-	50	ms/V
		V_{CC} = 3.0 V to 3.6 V	-	-	20	ms/V
		V_{CC} = 4.5 V to 5.5 V	-	-	1	ms/V

9. Static characteristics

Table 6. Static characteristics

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

Symbol	Parameter	Conditions	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} = 1.8 V	-	-	1.65	-	1.65	-	1.65	V
		V_{CC} = 2.3 V	-	-	1.85	-	1.85	-	1.85	V
		V_{CC} = 3.0 V	-	-	2.2	-	2.2	-	2.2	V
		V_{CC} = 4.5 V	-	-	3.15	-	3.15	-	3.15	V
		V_{CC} = 5.5 V	-	-	3.85	-	3.85	-	3.85	V
V_{T-}	negative-going threshold voltage	V_{CC} = 1.8 V	0.15	-	-	0.15	-	0.15	-	V
		V_{CC} = 2.3 V	0.45	-	-	0.45	-	0.45	-	V
		V_{CC} = 3.0 V	0.9	-	-	0.9	-	0.9	-	V
		V_{CC} = 4.5 V	1.35	-	-	1.35	-	1.35	-	V
		V_{CC} = 5.5 V	1.65	-	-	1.65	-	1.65	-	V
V_H	hysteresis voltage	V_{CC} = 1.8 V	0.15	-	1.05	0.15	1.05	0.15	1.05	V
		V_{CC} = 2.3 V	0.2	-	1.1	0.2	1.1	0.2	1.1	V
		V_{CC} = 3.0 V	0.3	-	1.2	0.3	1.2	0.3	1.2	V
		V_{CC} = 4.5 V	0.4	-	1.4	0.4	1.4	0.4	1.4	V
		V_{CC} = 5.5 V	0.5	-	1.6	0.5	1.6	0.5	1.6	V
V_{OL}	LOW-level output voltage	V_I = V_{T+} or V_{T-}								
		I_O = 50 µA; V_{CC} = 1.8 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 50 µA; V_{CC} = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 50 µA; V_{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 8 mA; V_{CC} = 3.0 V	-	-	0.36	-	0.44	-	0.44	V
		I_O = 16 mA; V_{CC} = 4.5 V	-	-	0.44	-	0.55	-	0.55	V
I_{OZ}	OFF-state output current	V_{CC} = 5.5 V; V_I = V_{IH} or V_{IL}; V_O = GND to 5.5 V	-	-	±0.25	-	±2.5	-	±2.5	µA
I_{OFF}	power-off leakage current	V_I or V_O = GND to 5.5 V; V_{CC} = 0 V	-	-	0.5	-	5	-	5	µA
I_I	input leakage current	V_I = V_{CC} or GND; V_{CC} = 0 V to 5.5 V	-	-	±0.1	-	±1	-	±1	µA
I_{CC}	supply current	V_I = V_{CC} or GND; I_O = 0 A; V_{CC} = 5.5 V	-	-	2	-	20	-	20	µA

9.1. Transfer characteristics waveforms

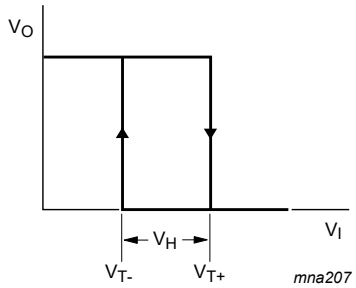


Fig. 5. Transfer characteristics

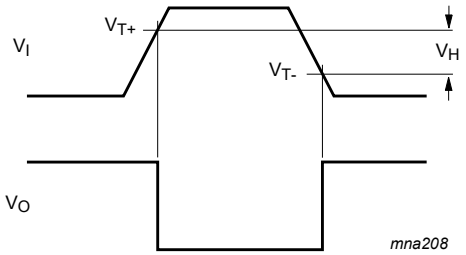
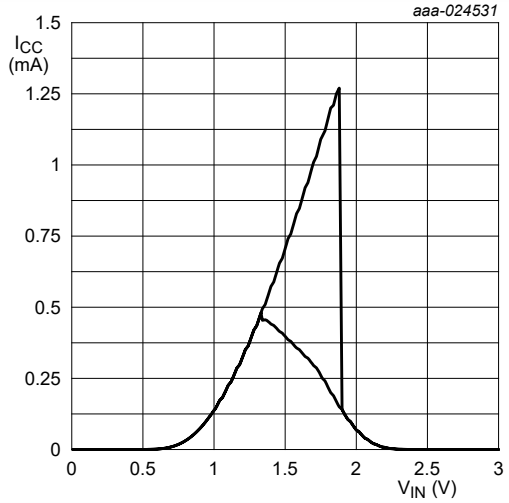
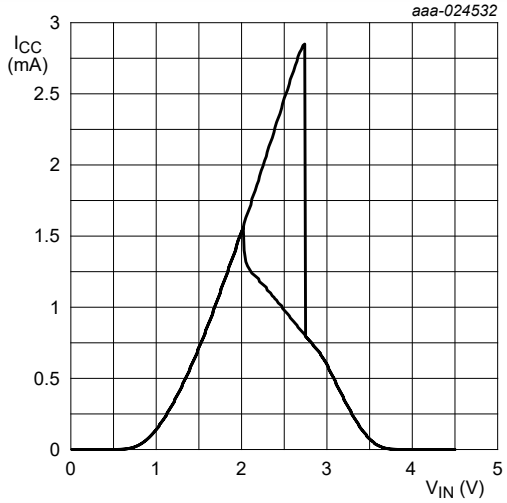


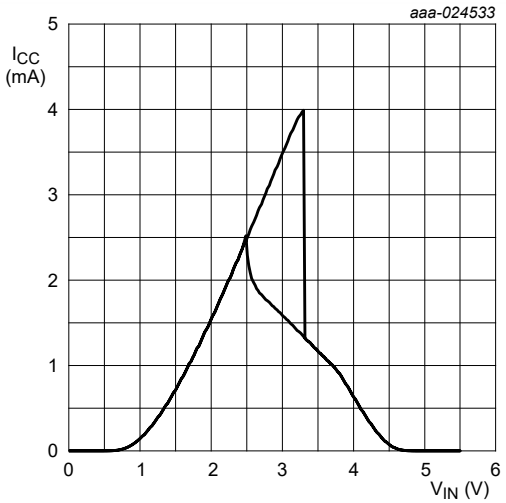
Fig. 6. Transfer characteristics definitions



a. V_{CC} = 3.0 V



b. V_{CC} = 4.5 V



c. V_{CC} = 5.5 V

Fig. 7. Typical transfer characteristics

10. Dynamic characteristics

Table 7. Dynamic characteristics

GND = 0 V. For test circuit see Fig. 9.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
t_{PZL}	OFF-state to LOW propagation delay	nA to nY; see Fig. 8								
		V_{CC} = 2.3 V to 2.7 V								
		C_L = 15 pF	-	5.8	12.2	1	15	1	17	ns
		C_L = 50 pF	-	8.2	16.6	1	19.5	1	21.5	ns
		V_{CC} = 3.0 V to 3.6 V								
		C_L = 15 pF	-	4.6	7.1	1	8.5	1	10.0	ns
		C_L = 50 pF	-	6.5	10.6	1	12	1	13.5	ns
		V_{CC} = 4.5 V to 5.5 V								
		C_L = 15 pF	-	3.6	5.5	1	6.5	1	7.5	ns
		C_L = 50 pF	-	5.3	7.5	1	8.5	1	9.5	ns
t_{PLZ}	LOW to OFF-state propagation delay	nA to nY; see Fig. 8								
		V_{CC} = 2.3 V to 2.7 V								
		C_L = 15 pF	-	5.4	10.5	1	12.0	1	14.0	ns
		C_L = 50 pF	-	10.0	15.2	1	18	1	20.0	ns
		V_{CC} = 3.0 V to 3.6 V								
		C_L = 15 pF	-	4.3	7.2	1	9.0	1	10.5	ns
		C_L = 50 pF	-	7.7	10.6	1	12	1	13.5	ns
		V_{CC} = 4.5 V to 5.5 V								
		C_L = 15 pF	-	3.4	5.5	1	6.5	1	7.5	ns
		C_L = 50 pF	-	5.6	7.5	1	8.5	1	9.5	ns
C_I	input capacitance	V_I = V_{CC} or GND; V_{CC} = 3.3 V	-	2	6	-	6	-	6	pF
C_O	output capacitance	V_O = V_{CC} or GND; V_{CC} = 3.3 V	-	5	-	-	-	-	-	pF
C_{PD}	power dissipation capacitance	per buffer; C_L = 0 pF; f = 10 MHz; V_{CC} = 5 V; V_I = GND to V_{CC} [2]	-	3	-	-	-	-	-	pF

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 2.5 V, 3.3 V, and 5 V respectively, unless otherwise specified.

[2] C_{PD} is used to determine the dynamic power dissipation P_D (µW).

$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o)$ where:

f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

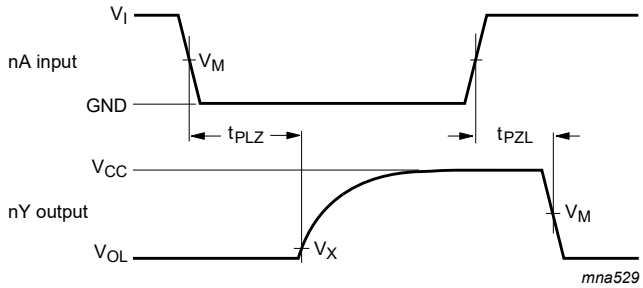
V_{CC} = supply voltage in Volts.

Table 8. Noise characteristics

GND = 0 V. For test circuit see Fig. 9.

Symbol	Parameter	Conditions	T_{amb} = 25 °C			Unit
			Min	Typ	Max	
V_{CC} = 3.3 V; C_L = 50 pF						
$V_{OL(p)}$	LOW-level output voltage (peak)		-	0.3	0.8	V
$V_{OL(v)}$	LOW-level output voltage (valley)		-0.8	-0.1	-	V
$V_{IH(AC)}$	AC HIGH-level input voltage (dynamic)		2.31	-	-	V
$V_{IL(AC)}$	AC LOW-level input voltage (dynamic)		-	-	0.99	V
V_{CC} = 5.0 V; C_L = 50 pF						
$V_{OL(p)}$	LOW-level output voltage (peak)		-	0.6	-	V
$V_{OL(v)}$	LOW-level output voltage (valley)		-	-0.4	-	V
$V_{IH(AC)}$	AC HIGH-level input voltage (dynamic)		3.5	-	-	V
$V_{IL(AC)}$	AC LOW-level input voltage (dynamic)		-	-	1.5	V

10.1. Waveforms and test circuit



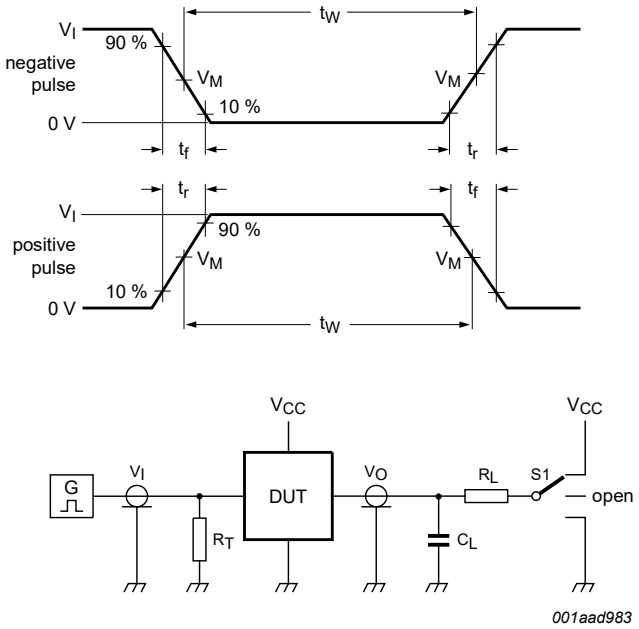
Measurement points are given in Table 9.

V_{OL} is the typical voltage output level that occurs with the output load.

Fig. 8. Propagation delay input (nA) to output (nY)

Table 9. Measurement points

Input	Output	
V_M	**V_M**	**V_X**
0.5 × V_{CC}	0.5 × V_{CC}	V_{OL} + 0.3 V



Test data is given in Table 10.

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

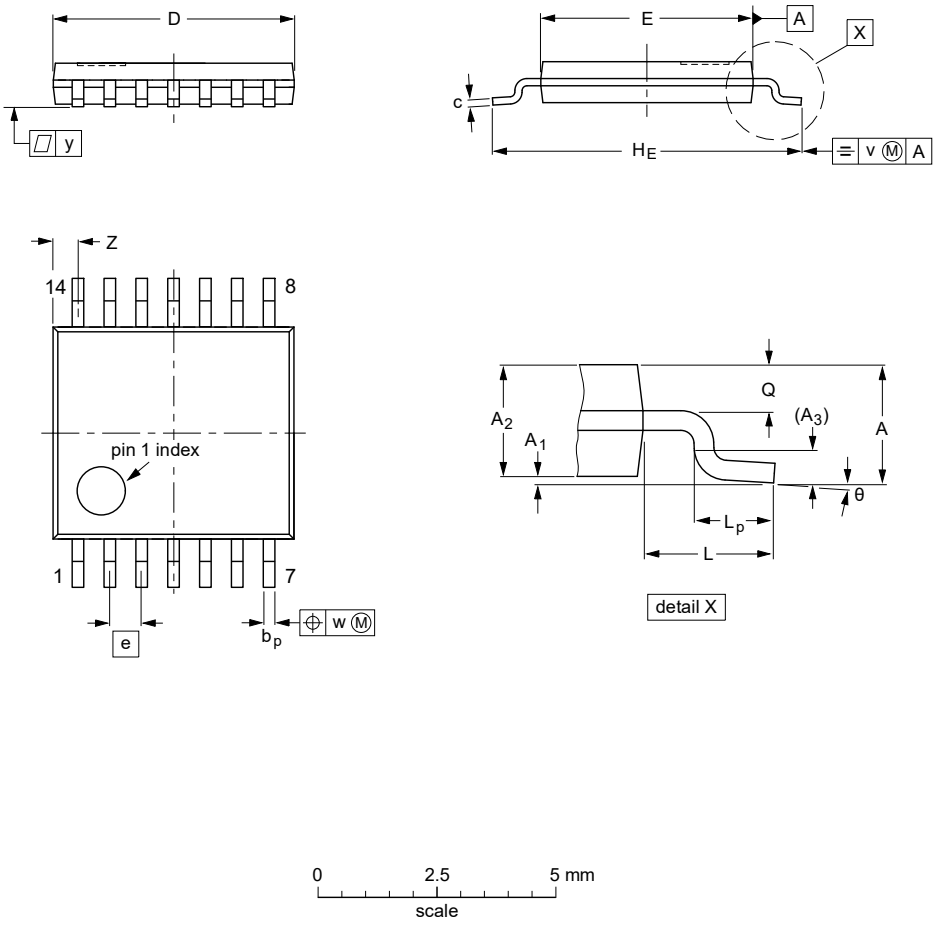
Fig. 9. Test circuit for measuring switching times

Table 10. Test data

Input		Load		S1 position
V_I	t_r, t_f	C_L	R_L	t_{PLZ}, t_{PZL}
GND to V_{CC}	3.0 ns	15 pF, 50 pF	1 kΩ	V_{CC}

11. Package outline

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm **SOT402-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.72 0.38	8° 0°

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT402-1		MO-153				~~99-12-27~~ 03-02-18

Fig. 10. Package outline SOT402-1 (TSSOP14)

12. Abbreviations

Table 11. Abbreviations

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

13. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHCV05A v.1	20190624	Product data sheet	-	-

14. Legal information

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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