

# 74ALVCH16952

16-bit registered transceiver; 3-state

Rev. 3 — 9 January 2018

Product data sheet

## 1 General description

The 74ALVCH16952 consists of two sections, each containing a dual octal non-inverting registered transceiver. Two 8-bit back to back registers store data flowing in both directions between two bidirectional buses. Data applied to the inputs is entered and stored on the rising edge of the clock (nCPAB and nCPBA) provided that the clock enable (nCEAB and nCEBA) is LOW. The data is then present at the output buffers, but is only accessible when the output enable input (nOEAB and nOEBA) is LOW. Data flow from A inputs to B outputs is the same as for B inputs to A outputs.

## 2 Features and benefits

- CMOS low-power consumption
- Multibyte flow-through pinout architecture
- Low inductance, multiple center power and ground pins for minimum noise and ground bounce
- Direct interface with TTL levels
- Output drive capability 50  $\Omega$  transmission lines at 85 °C
- Complies with JEDEC standard JESD8-B

## 3 Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74ALVCH16952DGG	-40 °C to +85 °C	TSSOP56	plastic thin shrink small outline package; 56 leads; body width 6.1 mm	SOT364-1

4 Functional diagram

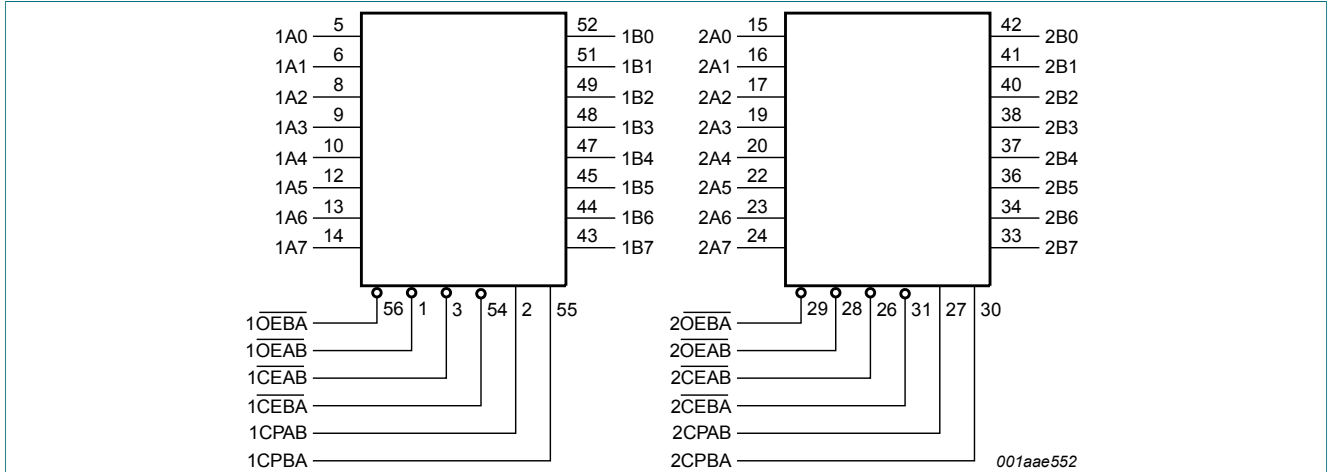


Figure 1. Logic symbol

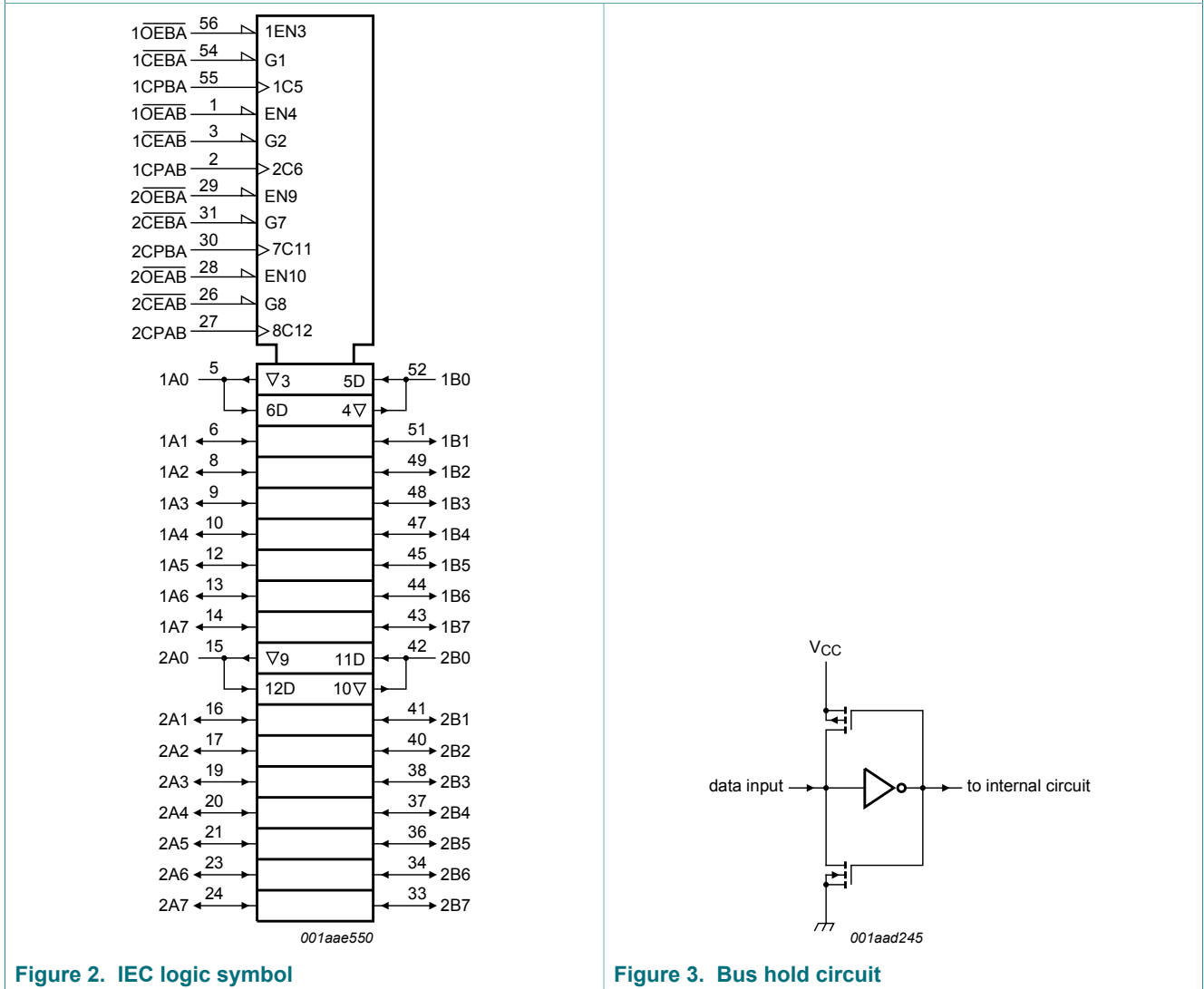


Figure 2. IEC logic symbol

Figure 3. Bus hold circuit

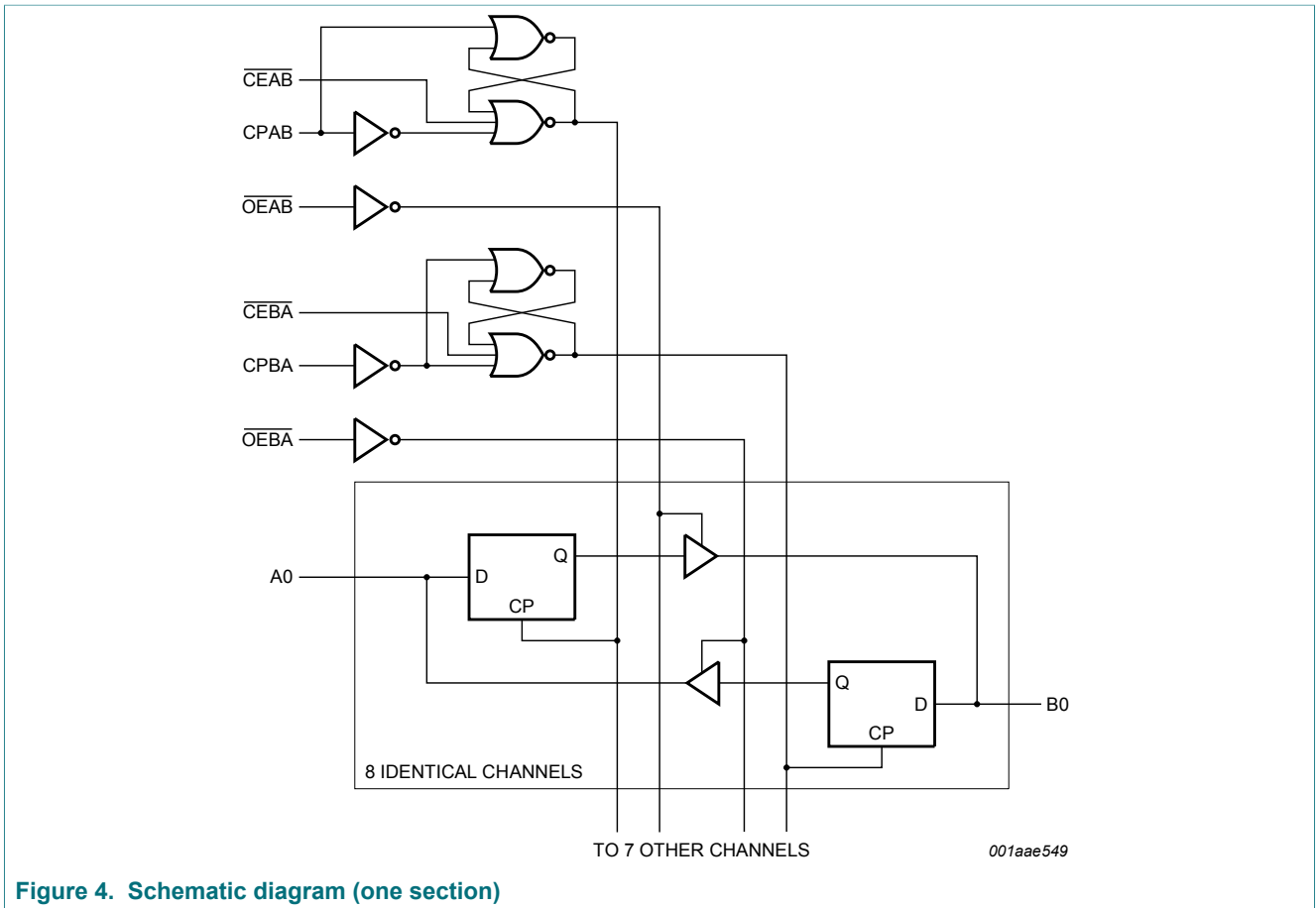


Figure 4. Schematic diagram (one section)

## 5 Pinning information

### 5.1 Pinning

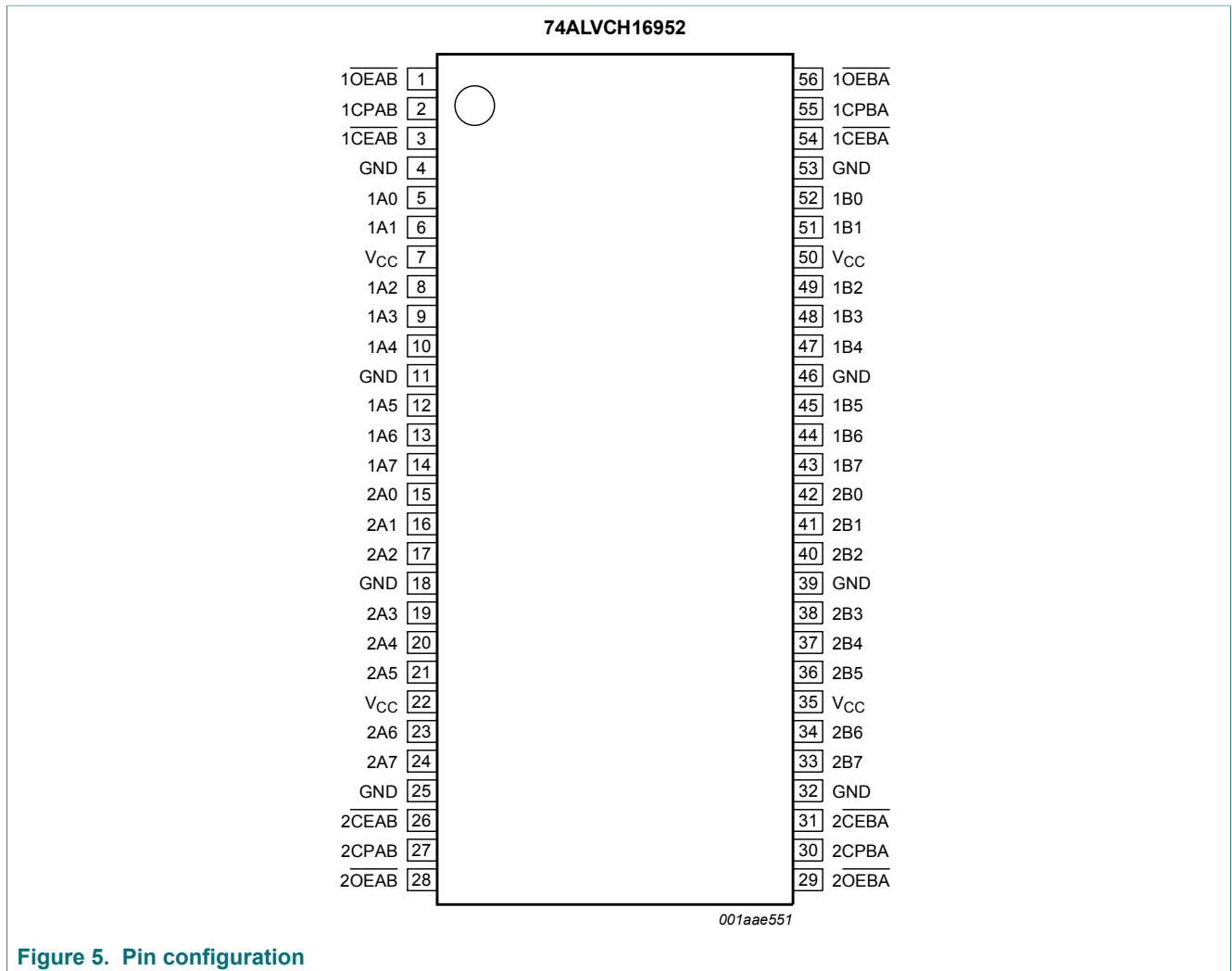


Figure 5. Pin configuration

## 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1A0, 1A1, 1A2, 1A3, 1A4, 1A5, 1A6, 1A7	5, 6, 8, 9, 10, 12, 13, 14	data inputs or outputs
1B0, 1B1, 1B2, 1B3, 1B4, 1B5, 1B6, 1B7	52, 51, 49, 48, 47, 45, 44, 43	data inputs or outputs
2A0, 2A1, 2A2, 2A3, 2A4, 2A5, 2A6, 2A7	15, 16, 17, 19, 20, 21, 23, 24	data inputs or outputs
2B0, 2B1, 2B2, 2B3, 2B4, 2B5, 2B6, 2B7	42, 41, 40, 38, 37, 36, 34, 33	data inputs or outputs
$1\overline{OEAB}$ , $1\overline{OEBA}$ , $2\overline{OEAB}$ , $2\overline{OEBA}$	1, 56, 28, 29	output enable input (active LOW)
$1\overline{CEAB}$ , $1\overline{CEBA}$ , $2\overline{CEAB}$ , $2\overline{CEBA}$	3, 54, 26, 31	clock enable input (active LOW)
1CPAB, 1CPBA, 2CPAB, 2CPBA	2, 55, 27, 30	clock pulse input (LOW-to-HIGH, edge-triggered)
GND	4, 11, 18, 25, 32, 39, 46, 53	ground (0 V)
V <sub>CC</sub>	7, 22, 35, 50	supply voltage

## 6 Functional description

Table 3. Function table <sup>[1]</sup>

Operating mode A to B, B to A	Control			Input nAn, nBn	Internal nQn	Output nBn, nAn
	$n\overline{OEAB}$ , $n\overline{OEBA}$	$n\overline{CEAB}$ , $n\overline{CEBA}$	$n\overline{CPAB}$ , $n\overline{CPBA}$			
Hold	L	H	X	X	NC	NC
Load and output enable	L	L	↑	L	L	L
				H	H	H
Load and output disable	H	L	↑	L	L	Z
				H	H	Z

- [1] H = HIGH voltage level;  
 L = LOW voltage level;  
 ↑ = LOW-to-HIGH clock transition;  
 X = don't care;  
 Z = high impedance OFF-state;  
 NC = no change.

## 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	+4.6	V
$V_I$	input voltage	control pins <sup>[1]</sup>	-0.5	+4.6	V
		data inputs <sup>[1]</sup>	-0.5	$V_{CC} + 0.5$	V
$V_O$	output voltage	<sup>[1]</sup>	-0.5	$V_{CC} + 0.5$	V
$I_{IK}$	input clamping current	$V_I < 0$ V	-	-50	mA
$I_{OK}$	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V	-	$\pm 50$	mA
$I_O$	output current	$V_O = 0$ V to $V_{CC}$	-	$\pm 50$	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 <sup>[2]</sup>	-	600	mW

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] For TSSOP56 package:  $P_{tot}$  derates linearly with 8 mW/K above 55 °C.

## 8 Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	maximum speed performance				
		$C_L = 30$ pF	2.3	-	2.7	V
		$C_L = 50$ pF	3.0	-	3.6	V
$V_I$	input voltage		0	-	$V_{CC}$	V
$V_O$	output voltage		0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature	operating in free-air	-40	-	+85	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.3$ V to 3.0 V	0	-	20	ns/V
		$V_{CC} = 3.0$ V to 3.6 V	0	-	10	ns/V

## 9 Static characteristics

**Table 6. Static characteristics**

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	1.2	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	1.5	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.3 V to 2.7 V	-	1.2	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	1.5	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		V <sub>CC</sub> = 2.3 V to 3.6 V; I <sub>O</sub> = -100 μA	V <sub>CC</sub> - 0.2	V <sub>CC</sub>	-	V
		V <sub>CC</sub> = 2.3 V; I <sub>O</sub> = -6 mA	V <sub>CC</sub> - 0.3	V <sub>CC</sub> - 0.08	-	V
		V <sub>CC</sub> = 2.3 V; I <sub>O</sub> = -12 mA	V <sub>CC</sub> - 0.6	V <sub>CC</sub> - 0.26	-	V
		V <sub>CC</sub> = 2.7 V; I <sub>O</sub> = -12 mA	V <sub>CC</sub> - 0.5	V <sub>CC</sub> - 0.14	-	V
		V <sub>CC</sub> = 3.0 V; I <sub>O</sub> = -12 mA	V <sub>CC</sub> - 0.6	V <sub>CC</sub> - 0.09	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		V <sub>CC</sub> = 2.3 V to 3.6 V; I <sub>O</sub> = 100 μA	-	GND	0.20	V
		V <sub>CC</sub> = 2.3 V; I <sub>O</sub> = 6 mA	-	0.07	0.40	V
		V <sub>CC</sub> = 2.3 V; I <sub>O</sub> = 12 mA	-	0.15	0.70	V
		V <sub>CC</sub> = 2.7 V; I <sub>O</sub> = 12 mA	-	0.14	0.40	V
		V <sub>CC</sub> = 3.0 V; I <sub>O</sub> = 24 mA	-	0.27	0.55	V
I <sub>I</sub>	input leakage current	V <sub>CC</sub> = 2.3 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND	-	0.1	5	μA
I <sub>OZ</sub>	OFF-state output current	V <sub>CC</sub> = 2.7 V to 3.6 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND	-	0.1	10	μA
I <sub>CC</sub>	supply current	V <sub>CC</sub> = 2.3 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A	-	0.2	40	μA
ΔI <sub>CC</sub>	additional supply current	V <sub>CC</sub> = 2.3 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A	-	150	750	μA
I <sub>BHL</sub>	bus hold LOW sustaining current	V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = 0.7 V	45	-	-	μA
		V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = 0.8 V	75	150	-	μA
I <sub>BHH</sub>	bus hold HIGH sustaining current	V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = 1.7 V	-45	-	-	μA
		V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = 2.0 V	-75	-175	-	μA
I <sub>BHLO</sub>	bus hold LOW overdrive current	V <sub>CC</sub> = 3.6 V	500	-	-	μA
I <sub>BHHO</sub>	bus hold HIGH overdrive current	V <sub>CC</sub> = 3.6 V	-500	-	-	μA
C <sub>i</sub>	input capacitance		-	3.0	-	pF

[1] Typical values are measured at T<sub>amb</sub> = 25 °C

Typical values for V<sub>CC</sub> = 2.3 V to 2.7 V are measured at V<sub>CC</sub> = 2.5 V

Typical values for V<sub>CC</sub> = 3.0 V to 3.6 V are measured at V<sub>CC</sub> = 3.3 V

## 10 Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V).  $T_{amb} = -40\text{ °C to }+85\text{ °C}$ ; For test circuit, see [Figure 9](#).

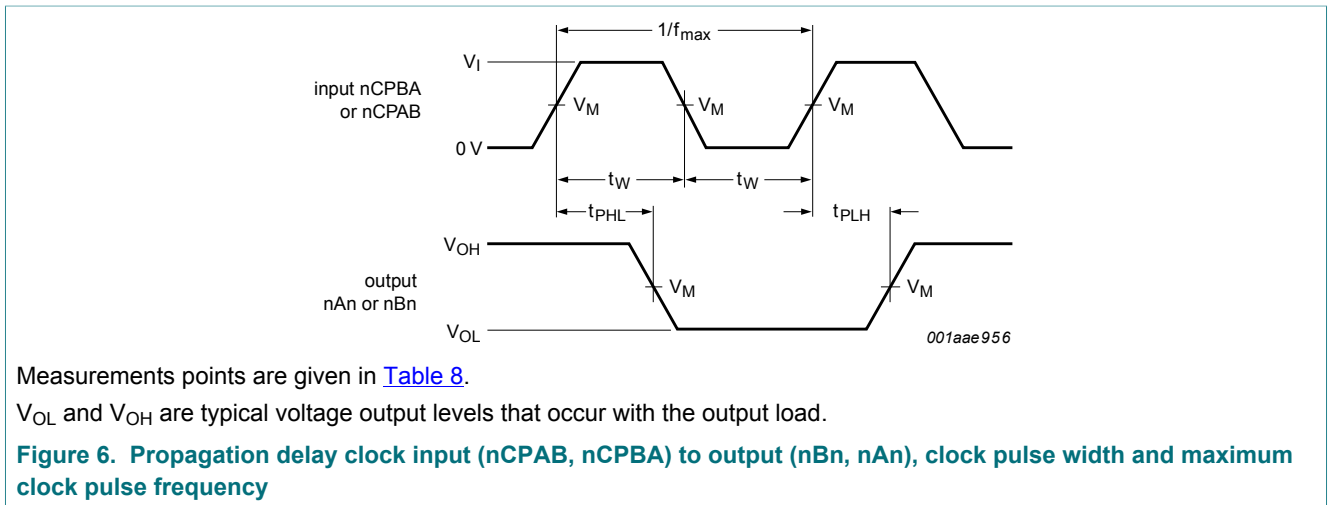
Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
$t_{pd}$	propagation delay	nCPBA to nAn; nCPAB to nBn; see <a href="#">Figure 6</a> <sup>[2]</sup>				
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	3.2	4.1	ns
		$V_{CC} = 2.7\text{ V}$	1.0	-	4.6	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	3.2	3.9	ns
$t_{en}$	enable time	n $\overline{OEBA}$ to nAn; n $\overline{OEAB}$ to nBn; see <a href="#">Figure 8</a> <sup>[3]</sup>				
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	-	5.4	ns
		$V_{CC} = 2.7\text{ V}$	1.0	-	5.3	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	-	4.4	ns
$t_{dis}$	disable time	n $\overline{OEBA}$ to nAn; n $\overline{OEAB}$ to nBn; see <a href="#">Figure 8</a> <sup>[4]</sup>				
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	-	5.3	ns
		$V_{CC} = 2.7\text{ V}$	1.4	-	4.4	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.1	-	4.0	ns
$t_w$	pulse width	nCPAB; nCPBA; HIGH or LOW; see <a href="#">Figure 6</a>				
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	3.3	-	-	ns
		$V_{CC} = 2.7\text{ V}$	3.3	-	-	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	3.3	-	-	ns
$t_{su}$	set-up time	nAn to nCPAB or nBn to nCPBA; see <a href="#">Figure 7</a>				
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.7	-	-	ns
		$V_{CC} = 2.7\text{ V}$	1.9	-	-	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.5	-	-	ns
		n $\overline{CEAB}$ to nCPAB or n $\overline{CEBA}$ to nCPBA; see <a href="#">Figure 7</a>				
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.2	-	-	ns
		$V_{CC} = 2.7\text{ V}$	1.0	-	-	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	-	-	ns
$t_h$	hold time	nAn to nCPAB or nBn to nCPBA; see <a href="#">Figure 7</a>				
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	0.6	-	-	ns
		$V_{CC} = 2.7\text{ V}$	0.6	-	-	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	0.8	-	-	ns
		n $\overline{CEAB}$ to nCPAB or n $\overline{CEBA}$ to nCPBA; see <a href="#">Figure 7</a>				
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.1	-	-	ns
		$V_{CC} = 2.7\text{ V}$	0.9	-	-	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.1	-	-	ns

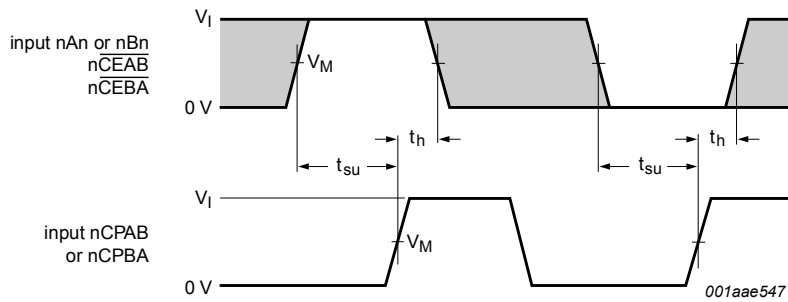


Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
f <sub>max</sub>	maximum frequency	CP; see <a href="#">Figure 6</a>				
		V <sub>CC</sub> = 2.3 V to 2.7 V	150	350	-	MHz
		V <sub>CC</sub> = 2.7 V	150	350	-	MHz
		V <sub>CC</sub> = 3.0 V to 3.6 V	150	350	-	MHz
C <sub>PD</sub>	power dissipation capacitance	per driver; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[5]</sup>	-	30	-	pF

- [1] Typical values are measured at T<sub>amb</sub> = 25 °C  
 Typical values for V<sub>CC</sub> = 2.3 V to 2.7 V are measured at V<sub>CC</sub> = 2.5 V  
 Typical values for V<sub>CC</sub> = 3.0 V to 3.6 V are measured at V<sub>CC</sub> = 3.3 V
- [2] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.
- [3] t<sub>en</sub> is the same as t<sub>PZH</sub> and t<sub>PZL</sub>.
- [4] t<sub>dis</sub> is the same as t<sub>PHZ</sub> and t<sub>PLZ</sub>.
- [5] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$  where:  
 f<sub>i</sub> = input frequency in MHz;  
 f<sub>o</sub> = output frequency in MHz;  
 C<sub>L</sub> = output load capacitance in pF;  
 V<sub>CC</sub> = supply voltage in V;  
 N = number of inputs switching;  
 $\sum(C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

### 10.1 Waveforms and test circuit

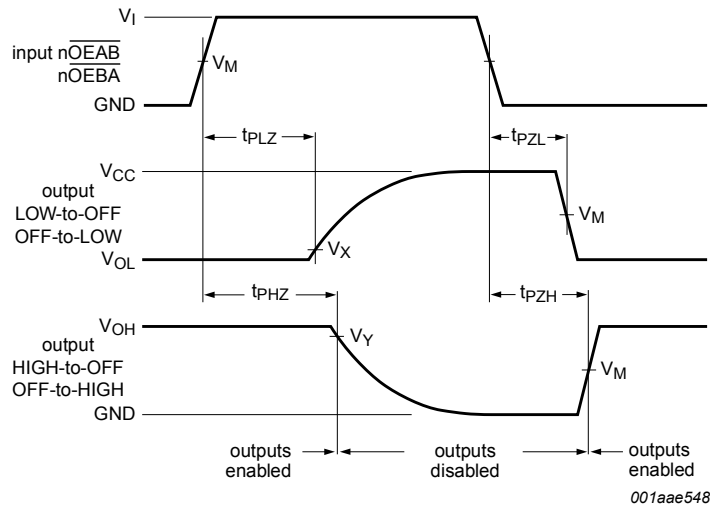




Measurements points are given in [Table 8](#).

The shaded areas indicate when the input is permitted to change for predictable output performance.

**Figure 7. Setup and hold times**



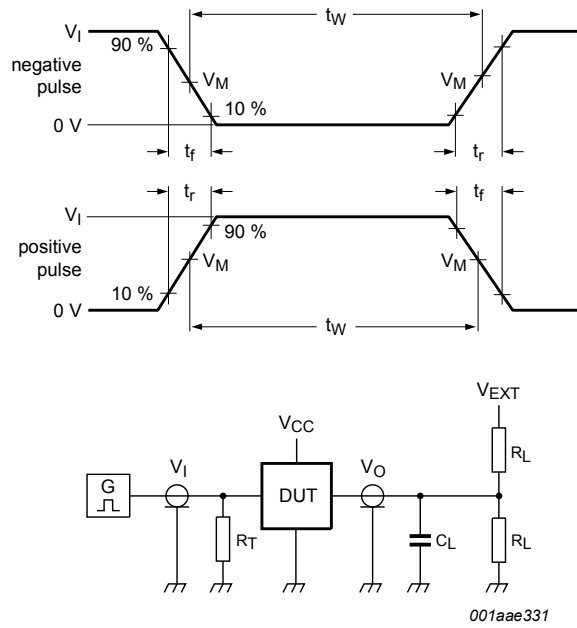
Measurements points are given in [Table 8](#).

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

**Figure 8. 3-state enable and disable time**

**Table 8. Measurement points**

Supply voltage	Input		Output		
$V_{CC}$	$V_I$	$V_M$	$V_M$	$V_X$	$V_Y$
2.3 V to 2.7 V	$V_{CC}$	0.5 V	0.5 V	$V_{OL} + 0.15$ V	$V_{OH} - 0.15$ V
2.7 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3$ V	$V_{OH} - 0.3$ V
3.0 V to 3.6 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3$ V	$V_{OH} - 0.3$ V



Test data is given in [Table 9](#).

Definitions for 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.

$V_{EXT}$  = External voltage for measuring switching times.

**Figure 9. Test circuit for measuring switching times**

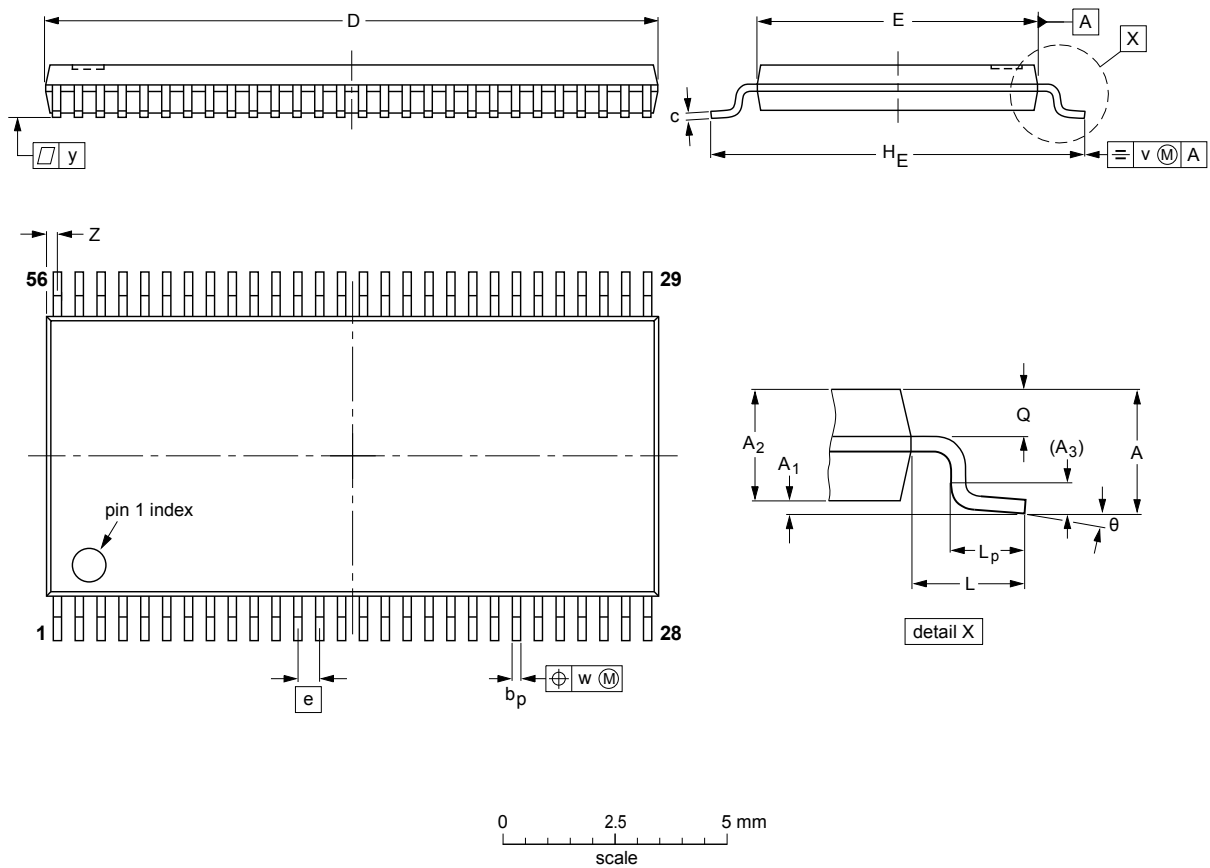
**Table 9. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
$V_{CC}$	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PLZ}, t_{PZL}$	$t_{PHZ}, t_{PZH}$
2.3 V to 2.7 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	2.5 ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	2.5 ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND

11 Package outline

TSSOP56: plastic thin shrink small outline package; 56 leads; body width 6.1 mm

SOT364-1



DIMENSIONS (mm are the original dimensions).

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(2)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z	θ
mm	1.2	0.15 0.05	1.05 0.85	0.25	0.28 0.17	0.2 0.1	14.1 13.9	6.2 6.0	0.5	8.3 7.9	1	0.8 0.4	0.50 0.35	0.25	0.08	0.1	0.5 0.1	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		
SOT364-1		MO-153			99-12-27 03-02-19

Figure 10. Package outline SOT364-1 (TSSOP56)

## 12 Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
TTL	Transistor-Transistor Logic

## 13 Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74ALVCH16952 v.3	20180109	Product data sheet	-	74ALVCH16952 v.2
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>			
74ALVCH16952 v.2	20060427	Product data sheet	-	74ALVCH16952 v.1
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors</li> <li>The symbol of pin numbers 15, 16, 17, 19, 20, 21, 23 and 24 is rectified</li> </ul>			
74ALVCH16952 v.1	19980901	Preliminary specification	-	-