74ALVCH16952

16-bit registered transceiver; 3-state

Rev. 4 — 10 July 2024 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 (n$\overline{\text{CEAB}}$ and n$\overline{\text{CEBA}}$) is LOW. The data is then present at the output buffers, but is only accessible when the output enable input (n$\overline{\text{OEAB}}$ and n$\overline{\text{OEBA}}$) 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 Ω transmission lines at 85 °C
- Complies with JEDEC standard JESD8-B
- 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

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

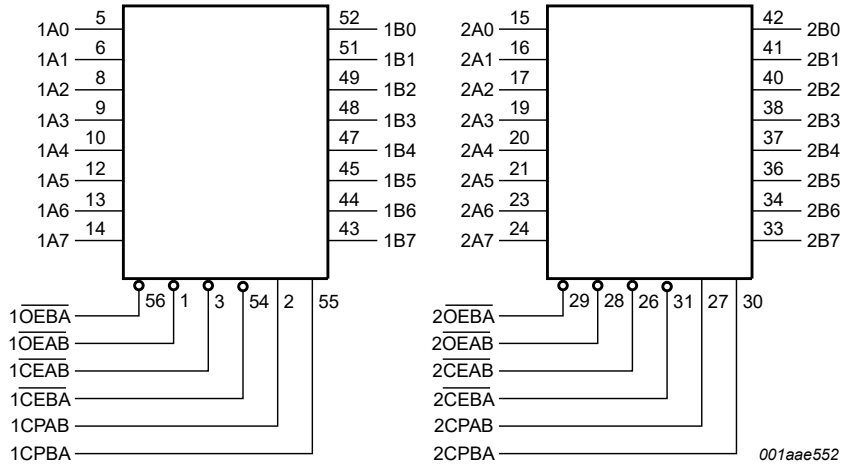


Fig. 1. Logic symbol

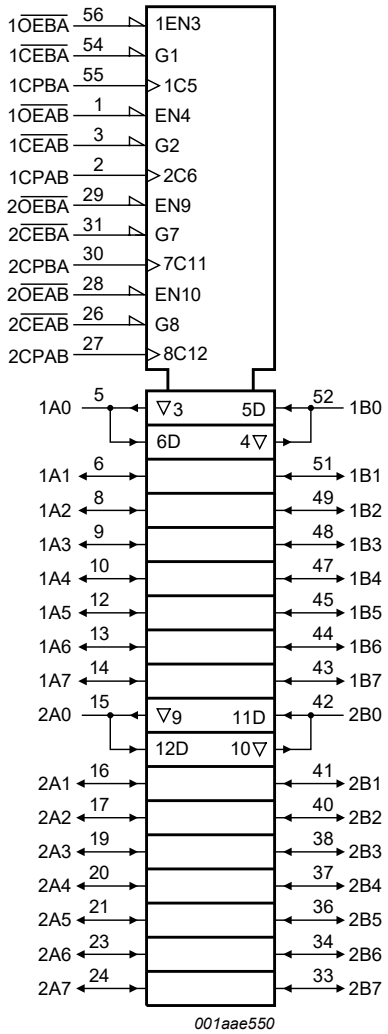


Fig. 2. IEC logic symbol

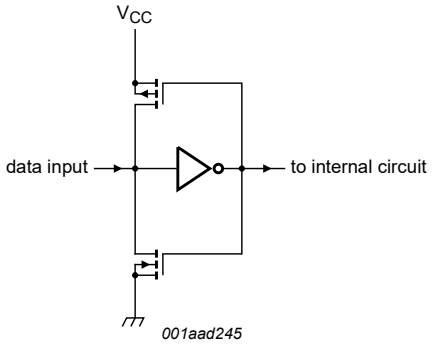


Fig. 3. Bus hold circuit

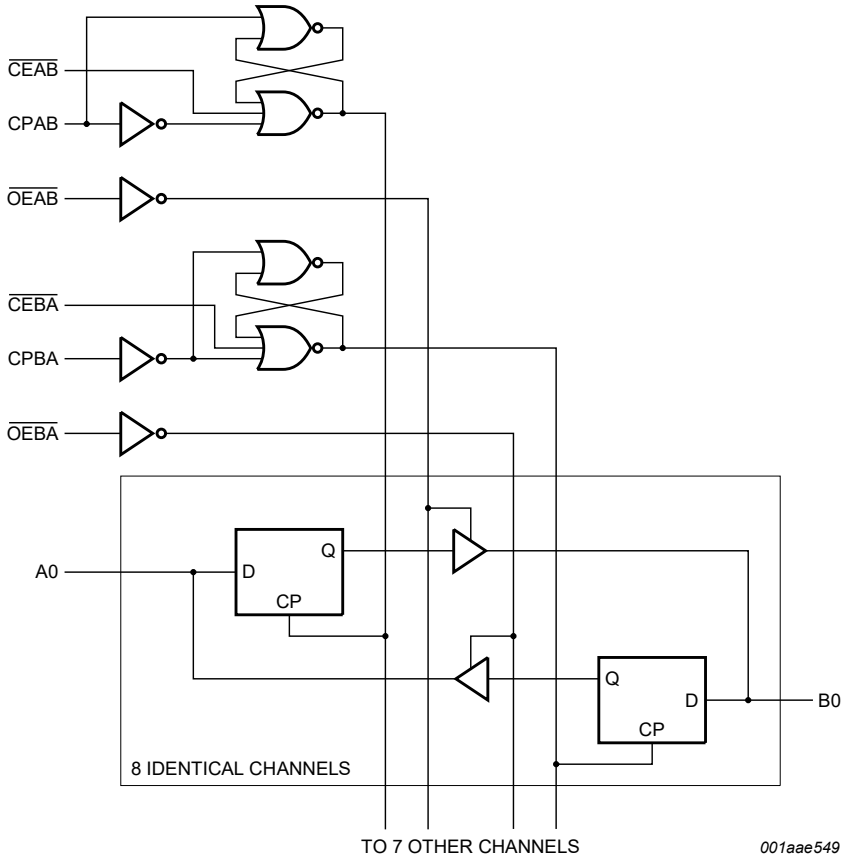
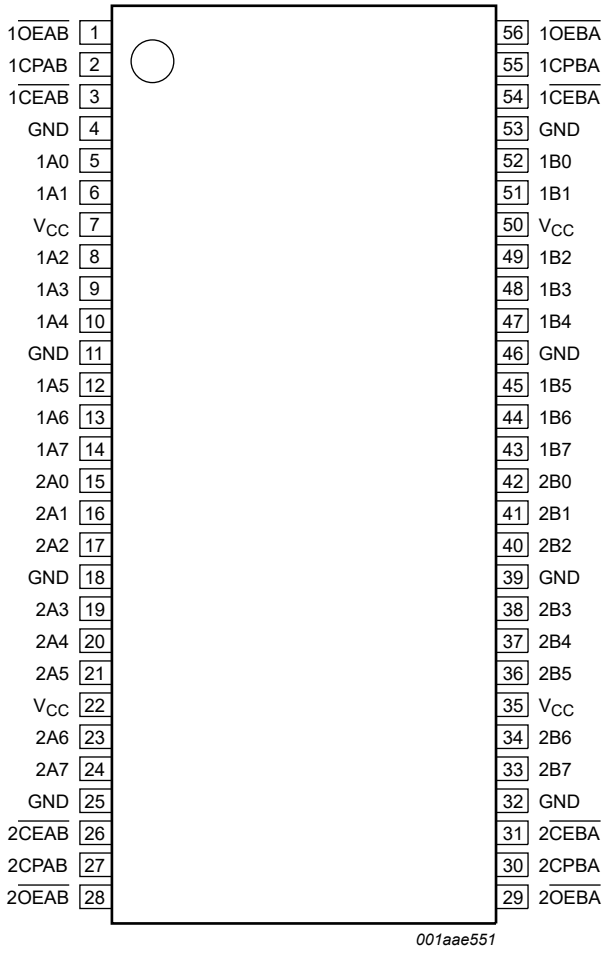


Fig. 4. Schematic diagram (one section)

5. Pinning information

5.1. Pinning



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_{CC}	7, 22, 35, 50	supply voltage

6. Functional description

Table 3. Function table

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.

Operating mode	Control			Input	Internal	Output
A to B, B to A	**$n\overline{OEAB}$, $n\overline{OEBA}$**	**$n\overline{CEAB}$, $n\overline{CEBA}$**	**nCPAB, nCPBA**	**nAn, nBn**	**nQn**	**nBn, nAn**
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

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	[1]	-0.5	+4.6	V
		data inputs	[1]	-0.5	V_{CC} + 0.5	V
V_O	output voltage		[1]	-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		-	±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 +85 °C		-	500	mW

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

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	-40 °C to +85 °C			Unit
			Min	Typ [1]	Max	
V_{IH}	HIGH-level input voltage	V_{CC} = 2.3 V to 2.7 V	1.7	1.2	-	V
		V_{CC} = 2.7 V to 3.6 V	2.0	1.5	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 2.3 V to 2.7 V	-	1.2	0.7	V
		V_{CC} = 2.7 V to 3.6 V	-	1.5	0.8	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}				
		V_{CC} = 2.3 V to 3.6 V; I_O = -100 µA	V_{CC} - 0.2	V_{CC}	-	V
		V_{CC} = 2.3 V; I_O = -6 mA	V_{CC} - 0.3	V_{CC} - 0.08	-	V
		V_{CC} = 2.3 V; I_O = -12 mA	V_{CC} - 0.6	V_{CC} - 0.26	-	V
		V_{CC} = 2.7 V; I_O = -12 mA	V_{CC} - 0.5	V_{CC} - 0.14	-	V
		V_{CC} = 3.0 V; I_O = -12 mA	V_{CC} - 0.6	V_{CC} - 0.09	-	V
		V_{CC} = 3.0 V; I_O = -24 mA	V_{CC} - 1.0	V_{CC} - 0.28	-	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}				
		V_{CC} = 2.3 V to 3.6 V; I_O = 100 µA	-	GND	0.20	V
		V_{CC} = 2.3 V; I_O = 6 mA	-	0.07	0.40	V
		V_{CC} = 2.3 V; I_O = 12 mA	-	0.15	0.70	V
		V_{CC} = 2.7 V; I_O = 12 mA	-	0.14	0.40	V
		V_{CC} = 3.0 V; I_O = 24 mA	-	0.27	0.55	V
I_I	input leakage current	V_{CC} = 2.3 V to 3.6 V; V_I = V_{CC} or GND	-	0.1	5	µA
I_{OZ}	OFF-state output current	V_{CC} = 2.7 V to 3.6 V; V_I = V_{IH} or V_{IL}; V_O = V_{CC} or GND	-	0.1	10	µA
I_{CC}	supply current	V_{CC} = 2.3 V to 3.6 V; V_I = V_{CC} or GND; I_O = 0 A	-	0.2	40	µA
ΔI_{CC}	additional supply current	V_{CC} = 2.3 V to 3.6 V; V_I = V_{CC} - 0.6 V; I_O = 0 A	-	150	750	µA
I_{BHL}	bus hold LOW sustaining current	V_{CC} = 2.3 V; V_I = 0.7 V	45	-	-	µA
		V_{CC} = 3.0 V; V_I = 0.8 V	75	150	-	µA

Symbol	Parameter	Conditions	-40 °C to +85 °C			Unit
			Min	Typ [1]	Max	
I_{BHH}	bus hold HIGH sustaining current	V_{CC} = 2.3 V; V_I = 1.7 V	-45	-	-	µA
		V_{CC} = 3.0 V; V_I = 2.0 V	-75	-175	-	µA
I_{BHLO}	bus hold LOW overdrive current	V_{CC} = 3.6 V	500	-	-	µA
I_{BHHO}	bus hold HIGH overdrive current	V_{CC} = 3.6 V	-500	-	-	µA
C_i	input capacitance		-	3.0	-	pF

[1] Typical values are measured at T_{amb} = 25 °C.
Typical values for V_{CC} = 2.3 V to 2.7 V are measured at V_{CC} = 2.5 V.
Typical values for V_{CC} = 3.0 V to 3.6 V are measured at V_{CC} = 3.3 V.

10. Dynamic characteristics

Table 7. Dynamic characteristics

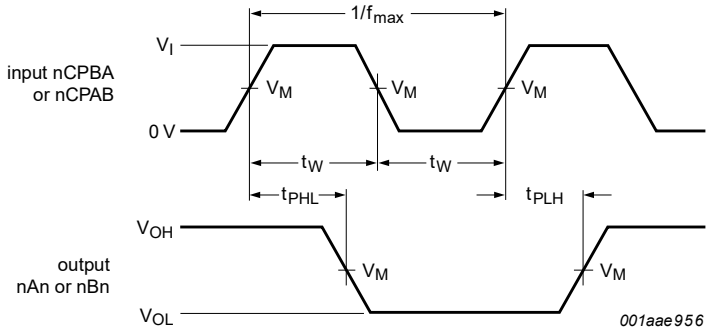
Voltages are referenced to GND (ground = 0 V). For test circuit, see Fig. 8.

Symbol	Parameter	Conditions	-40 °C to +85 °C			Unit
			Min	Typ [1]	Max	
t_{pd}	propagation delay	nCPBA to nAn; nCPAB to nBn; see Fig. 5 [2]				
		V_{CC} = 2.3 V to 2.7 V	1.0	3.2	4.1	ns
		V_{CC} = 2.7 V	1.0	-	4.6	ns
		V_{CC} = 3.0 V to 3.6 V	1.0	3.2	3.9	ns
t_{en}	enable time	$n\overline{OEBA}$ to nAn; $n\overline{OEAB}$ to nBn; see Fig. 7 [2]				
		V_{CC} = 2.3 V to 2.7 V	1.0	-	5.4	ns
		V_{CC} = 2.7 V	1.0	-	5.3	ns
		V_{CC} = 3.0 V to 3.6 V	1.0	-	4.4	ns
t_{dis}	disable time	$n\overline{OEBA}$ to nAn; $n\overline{OEAB}$ to nBn; see Fig. 7 [2]				
		V_{CC} = 2.3 V to 2.7 V	1.0	-	5.3	ns
		V_{CC} = 2.7 V	1.4	-	4.4	ns
		V_{CC} = 3.0 V to 3.6 V	1.1	-	4.0	ns
t_w	pulse width	nCPAB; nCPBA; HIGH or LOW; see Fig. 5				
		V_{CC} = 2.3 V to 2.7 V	3.3	-	-	ns
		V_{CC} = 2.7 V	3.3	-	-	ns
		V_{CC} = 3.0 V to 3.6 V	3.3	-	-	ns
t_{su}	set-up time	nAn to nCPAB or nBn to nCPBA; see Fig. 6				
		V_{CC} = 2.3 V to 2.7 V	1.7	-	-	ns
		V_{CC} = 2.7 V	1.9	-	-	ns
		V_{CC} = 3.0 V to 3.6 V	1.5	-	-	ns
		$n\overline{CEAB}$ to nCPAB; $n\overline{CEBA}$ to nCPBA; see Fig. 6				
		V_{CC} = 2.3 V to 2.7 V	1.2	-	-	ns
		V_{CC} = 2.7 V	1.0	-	-	ns
		V_{CC} = 3.0 V to 3.6 V	1.0	-	-	ns

Symbol	Parameter	Conditions	-40 °C to +85 °C			Unit
			Min	Typ [1]	Max	
t_h	hold time	nAn to nCPAB or nBn to nCPBA; see Fig. 6				
		V_{CC} = 2.3 V to 2.7 V	0.6	-	-	ns
		V_{CC} = 2.7 V	0.6	-	-	ns
		V_{CC} = 3.0 V to 3.6 V	0.8	-	-	ns
		$n\overline{CEAB}$ to nCPAB; $n\overline{CEBA}$ to nCPBA; see Fig. 6				
		V_{CC} = 2.3 V to 2.7 V	1.1	-	-	ns
		V_{CC} = 2.7 V	0.9	-	-	ns
		V_{CC} = 3.0 V to 3.6 V	1.1	-	-	ns
f_{max}	maximum frequency	CP; see Fig. 5				
		V_{CC} = 2.3 V to 2.7 V	150	350	-	MHz
		V_{CC} = 2.7 V	150	350	-	MHz
		V_{CC} = 3.0 V to 3.6 V	150	350	-	MHz
C_{PD}	power dissipation capacitance	per driver; V_I = GND to V_{CC} [3]	-	30	-	pF

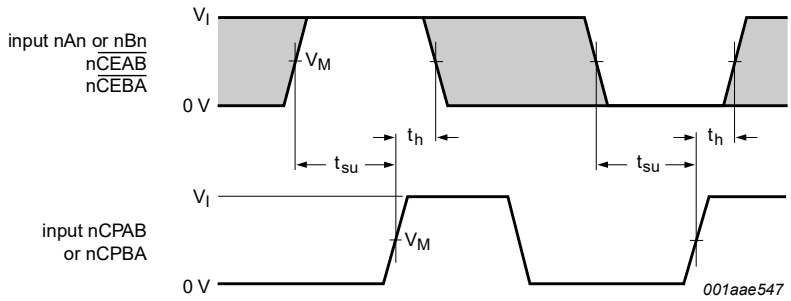
[1] Typical values are measured at T_{amb} = 25 °C.
Typical values for V_{CC} = 2.3 V to 2.7 V are measured at V_{CC} = 2.5 V.
Typical values for V_{CC} = 3.0 V to 3.6 V are measured at V_{CC} = 3.3 V.
[2] t_{pd} is the same as t_{PHL} and t_{PLH}; t_{en} is the same as t_{PZH} and t_{PZL}; t_{dis} is the same as t_{PHZ} and t_{PLZ}.
[3] C_{PD} is used to determine the dynamic power dissipation (P_D in µW):
$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$ 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 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.
V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

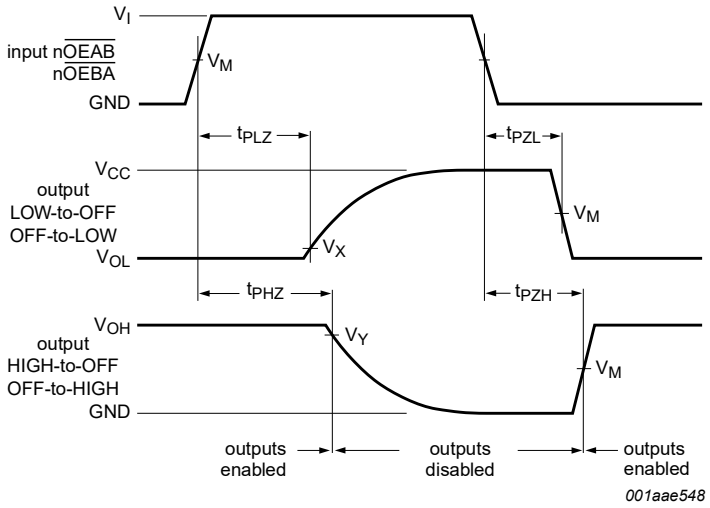
Fig. 5. Propagation delay clock input (nCPAB, nCPBA) to output (nBn, nAn), clock pulse width and maximum clock pulse frequency



Measurements points are given in Table 8.

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

Fig. 6. Setup and hold times



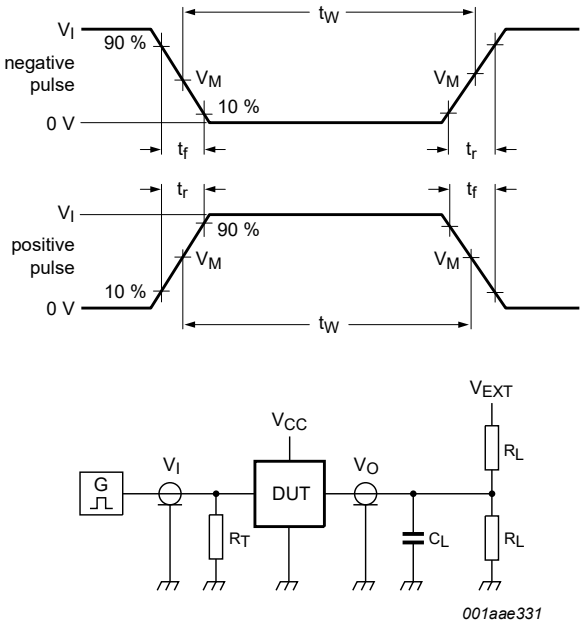
Measurements points are given in Table 8.

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

Fig. 7. 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.

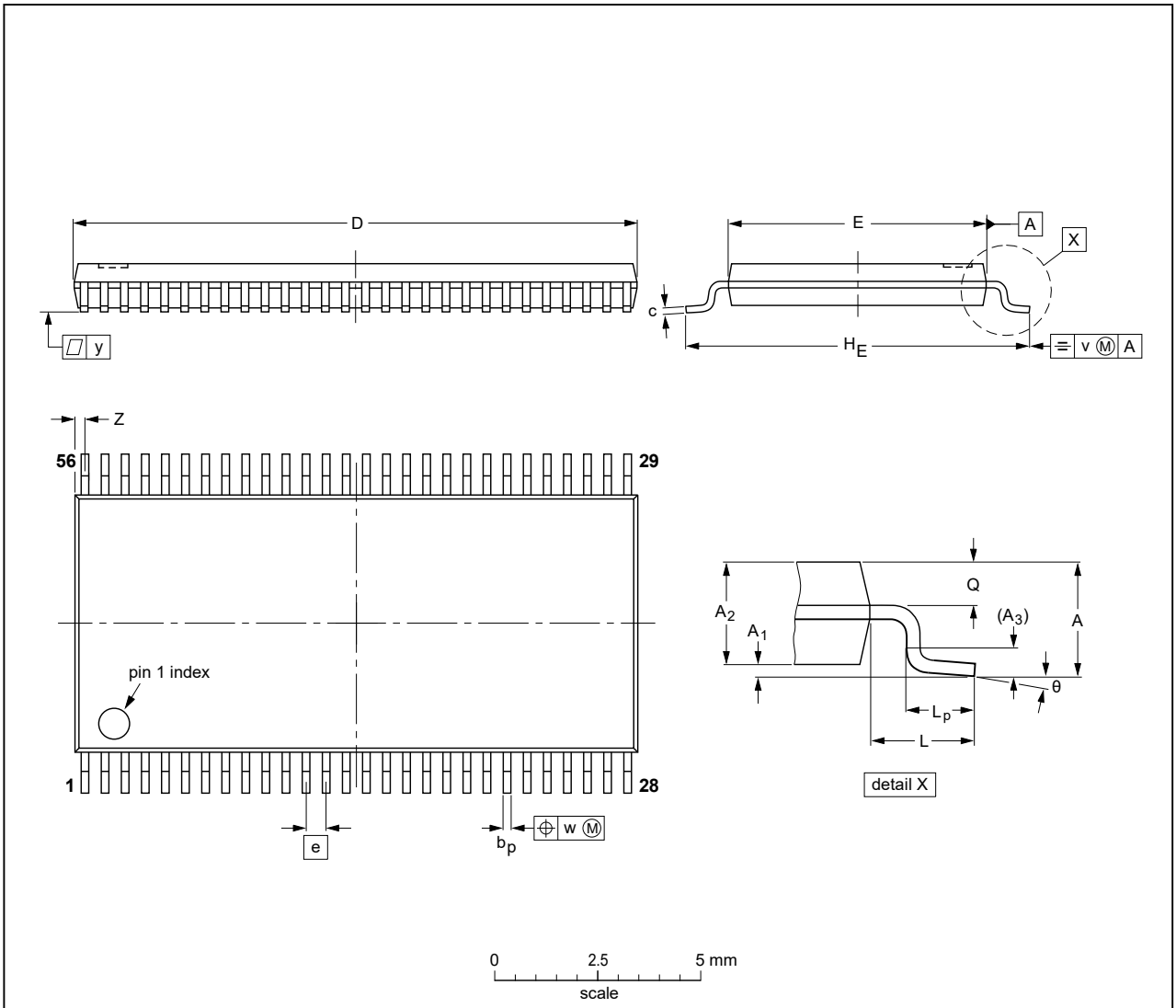
Fig. 8. Test circuit for measuring switching times

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}	≤ 2.0 ns	30 pF	500 Ω	open	2 × V_{CC}	GND
2.7 V	2.7 V	2.5 ns	50 pF	500 Ω	open	2 × V_{CC}	GND
3.0 V to 3.6 V	2.7 V	2.5 ns	50 pF	500 Ω	open	2 × 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_1	A_2	A_3	b_p	c	D(1)	E(2)	e	H_E	L	L_p	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

Fig. 9. Package outline SOT364-1 (TSSOP56)

12. Abbreviations

Table 10. Abbreviations

Acronym	Description
ANSI	American National Standards Institute
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
ESDA	ElectroStatic Discharge Association
HBM	Human Body Model
JEDEC	Joint Electron Device Engineering Council
TTL	Transistor-Transistor Logic

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74ALVCH16952 v.4	20240710	Product data sheet	-	74ALVCH16952 v.3
Modifications:	• Section 2: ESD specification updated according to the latest JEDEC standard. • Fig. 1: corrected pinnumber for 2A5. • Table 4: P_{tot} total power dissipation updated.			
74ALVCH16952 v.3	20180109	Product data sheet	-	74ALVCH16952 v.2
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.			
74ALVCH16952 v.2	20060427	Product data sheet	-	74ALVCH16952 v.1
Modifications:	• The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors • The symbol of pin numbers 15, 16, 17, 19, 20, 21, 23 and 24 is rectified			
74ALVCH16952 v.1	19980901	Preliminary specification	-	-

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.

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
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