74ALVCH16501

18-bit universal bus transceiver; 3-state

Rev. 6 — 13 March 2019 Product data sheet

1. General description

The 74ALVCH16501 is an 18-bit transceiver featuring non-inverting 3-state bus compatible outputs in both send and receive directions. Data flow in each direction is controlled by output enable (OEAB and $\overline{\text{OEBA}}$), latch enable (LEAB and LEBA), and clock (CPAB and CPBA) inputs. For A-to-B data flow, the device operates in the transparent mode when LEAB is HIGH. When LEAB is LOW, the A data is latched if CPAB is held at a HIGH or LOW logic level. If LEAB is LOW, the A-bus data is stored in the latch/flip-flop on the LOW-to-HIGH transition of CPAB. When OEAB is HIGH, the outputs are active. When OEAB is LOW, the outputs are in the high-impedance state.

Data flow for B-to-A is similar to that of A-to-B but uses $\overline{\text{OEBA}}$, LEBA and CPBA. The output enables are complimentary (OEAB is active HIGH, and $\overline{\text{OEBA}}$ is active LOW.

To ensure the high-impedance state during power-up or power-down, $\overline{\text{OEBA}}$ should be tied to V_{CC} through a pull-up resistor and OEAB should be tied to GND through a pull-down resistor; the minimum value of the resistor is determined by the current-sinking/current-sourcing capability of the driver.

Active bus hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

2. Features and benefits

- Wide supply voltage range from 1.2 V to 3.6 V
- Complies with JEDEC standard JESD8-B
- CMOS low power consumption
- Direct interface with TTL levels
- Current drive ±24 mA at V_{CC} = 3.0 V
- Universal bus transceiver with D-type latches and D-type flip-flops capable of operating in transparent, latched or clocked mode
- All inputs have bus hold circuitry
- Output drive capability 50 Ω transmission lines at 85 °C
- 3-state non-inverting outputs for bus-oriented applications

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74ALVCH16501DGG	-40 °C to +85 °C	TSSOP56	plastic thin shrink small outline package; 56 leads; body width 6.1 mm	SOT364-1

4. Functional diagram

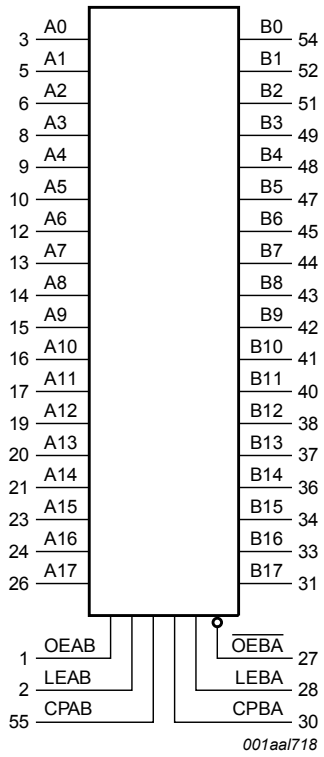


Fig. 1. Logic symbol

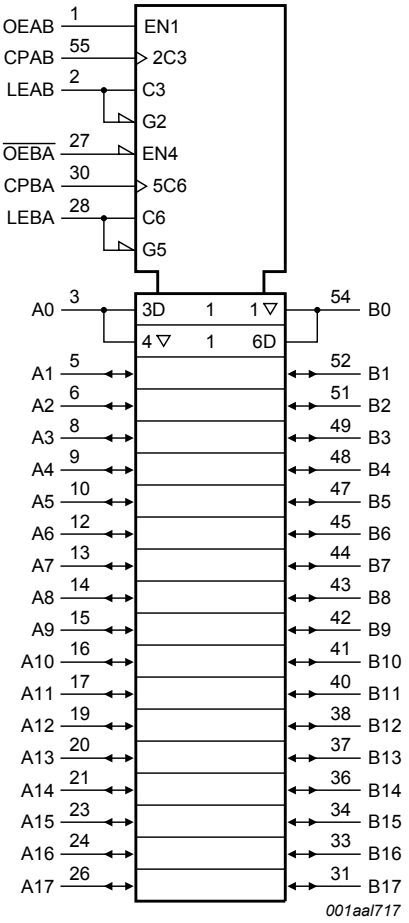


Fig. 2. IEC logic symbol

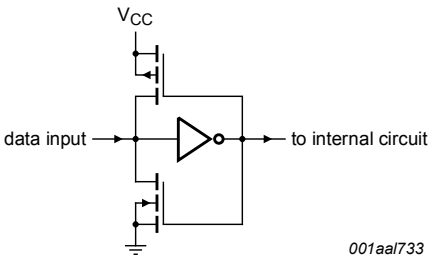


Fig. 3. Bus hold circuit

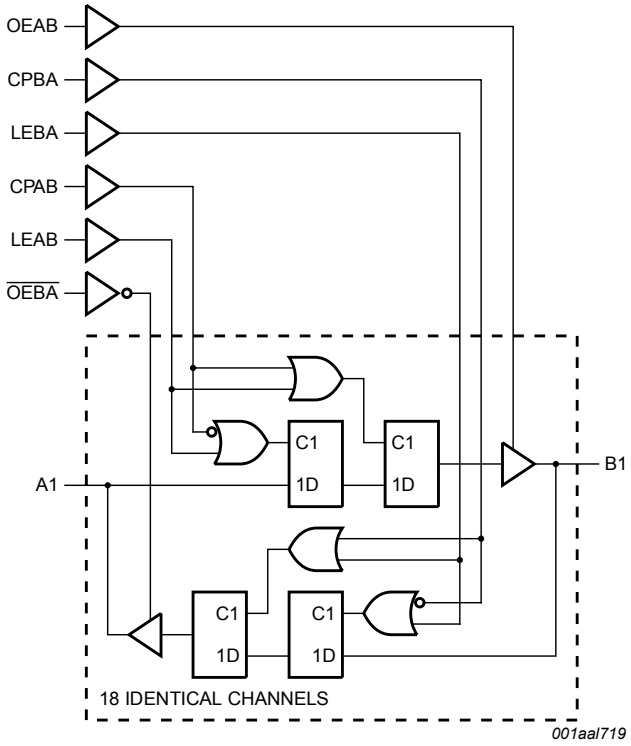


Fig. 4. Logic diagram

5. Pinning information

5.1. Pinning

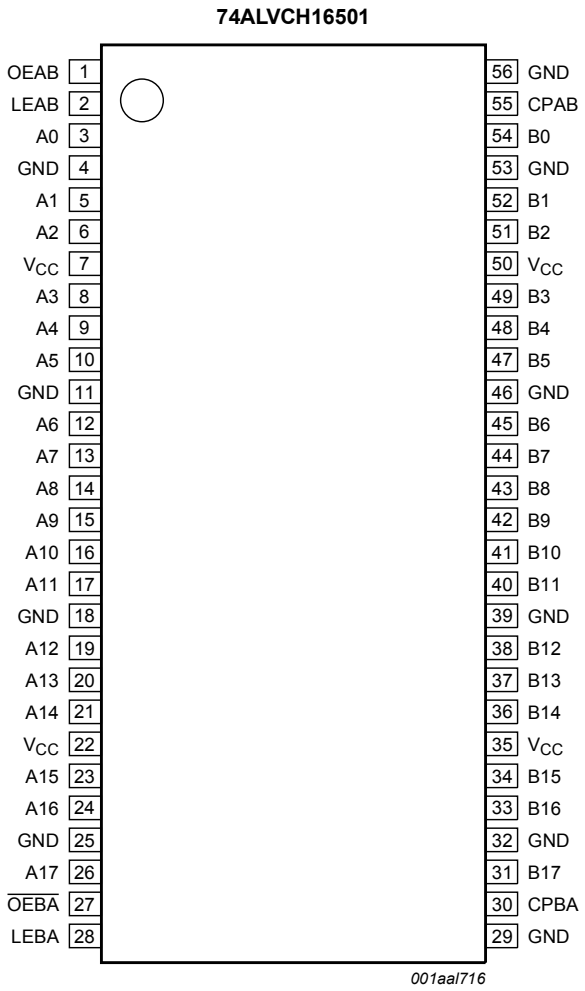


Fig. 5. Pin configuration SOT364-1 (TSSOP56)

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
OEAB	1	output enable A-to-B input (active HIGH)
LEAB	2	latch enable A-to-B input
A0 to A17	3, 5, 6, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 21, 23, 24, 26	data inputs or outputs
GND	4, 11, 18, 25, 29, 32, 39, 46, 53, 56	ground (0 V)
V_{CC}	7, 22, 35, 50	positive supply voltage
$\overline{OEBA}$	27	output enable B-to-A (active LOW)
LEBA	28	latch enable B-to-A
CPBA	30	clock input B-to-A
B0 to B17	54, 52, 51, 49, 48, 47, 45, 44, 43, 42, 41, 40, 38, 37, 36, 34, 33, 31	data inputs or outputs
CPAB	55	clock input A-to-B

6. Functional description

Table 3. Function table

A-to-B data flow is shown; B-to-A flow is similar but uses $\overline{OEBA}$, LEBA and CPBA.
H = HIGH voltage level;
h = HIGH voltage level one set-up time prior to the enable or clock transition;
L = LOW voltage level;
l = LOW voltage level one set-up time prior to the enable or clock transition;
X = don't care;
Z = high-impedance OFF-state;
↓ = HIGH-to-LOW clock transition;
↑ = LOW-to-HIGH clock transition.

Inputs				Output	Operating mode
OEAB	LEAB	CPAB	An	Bn	
L	X	X	X	Z	disabled
H	H	X	H	H	transparent
H	H	X	L	L	
H	↓	X	h	H	latch data and display
H	↓	X	l	L	
H	L	↑	h	H	clock data and display
H	L	↑	l	L	
H	L	H or L	X	H	hold data and display
H	L	H or L	X	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	+4.6	V
I_{IK}	input clamping current	$V_I < 0$ V		-50	-	mA
V_I	input voltage	control inputs	[1]	-0.5	+4.6	V
		data inputs	[1]	-0.5	V_{CC} + 0.5	V
I_{OK}	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V		-	±50	mA
V_O	output voltage		[1]	-0.5	V_{CC} + 0.5	V
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	[2]	-	600	mW

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2] Above 55 °C the value of P_{tot} derates linearly with 8 mW/K.

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
		low-voltage applications	1.2	-	3.6	V
V_I	input voltage		0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature	in free air	-40	-	+85	°C
Δt/ΔV	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	Min	Typ [1]	Max	Unit
T_{amb} = -40 °C to +85 °C						
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}				
		I_O = -100 µA; V_{CC} = 2.3 V to 3.6 V	V_{CC} - 0.2	V_{CC}	-	V
		I_O = -6 mA; V_{CC} = 2.3 V	V_{CC} - 0.3	V_{CC} - 0.08	-	V
		I_O = -12 mA; V_{CC} = 2.3 V	V_{CC} - 0.6	V_{CC} - 0.26	-	V
		I_O = -12 mA; V_{CC} = 2.7 V	V_{CC} - 0.5	V_{CC} - 0.14	-	V
		I_O = -12 mA; V_{CC} = 3.0 V	V_{CC} - 0.6	V_{CC} - 0.09	-	V
		I_O = -24 mA; V_{CC} = 3.0 V	V_{CC} - 1.0	V_{CC} - 0.28	-	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}				
		I_O = 100 µA; V_{CC} = 2.3 V to 3.6 V	-	GND	0.20	V
		I_O = 6 mA; V_{CC} = 2.3 V	-	0.07	0.40	V
		I_O = 12 mA; V_{CC} = 2.3 V	-	0.15	0.70	V
		I_O = 12 mA; V_{CC} = 2.7 V	-	0.14	0.40	V
		I_O = 24 mA; V_{CC} = 3.0 V	-	0.27	0.55	V
I_I	input leakage current	V_I = V_{CC} or GND; V_{CC} = 2.3 V to 3.6 V	-	0.1	5	µA
I_{OZ}	OFF-state output current	V_I = V_{IH} or V_{IL}; V_O = V_{CC} or GND; V_{CC} = 2.7 V to 3.6 V	-	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	per data I/O pin; 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 current	V_{CC} = 2.3 V; V_I = 0.7 V [2]	45	-	-	µA
		V_{CC} = 3.0 V; V_I = 0.8 V [2]	75	150	-	µA
I_{BHH}	bus hold HIGH current	V_{CC} = 2.3 V; V_I = 1.7 V [2]	-45	-	-	µA
		V_{CC} = 3.0 V; V_I = 2.0 V [2]	-75	-175	-	µA
I_{BHLO}	bus hold LOW overdrive current	V_{CC} = 3.6 V [2]	500	-	-	µA
I_{BHHO}	bus hold HIGH overdrive current	V_{CC} = 3.6 V [2]	-500	-	-	µA
C_I	input capacitance		-	4.0	-	pF
$C_{I/O}$	input/output capacitance		-	8.0	-	pF

[1] All typical values are measured at T_{amb} = 25 °C.
[2] Valid for data inputs of bus hold parts only.

10. Dynamic characteristics

Table 7. Dynamic characteristics

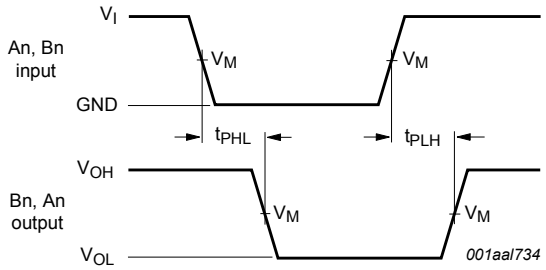
At recommended operating conditions. Voltages are referenced to GND (ground = 0 V); test circuit Fig. 10.

Symbol	Parameter	Conditions		Min	Typ [1]	Max	Unit
T_{amb} = -40 °C to +85 °C							
f_{max}	maximum frequency	see Fig. 8					
		V_{CC} = 2.3 V to 2.7 V	[2]	150	333	-	MHz
		V_{CC} = 3.0 V to 3.6 V	[3]	150	340	-	MHz
		V_{CC} = 2.7 V		150	333	-	MHz
t_{pd}	propagation delay	An to Bn; Bn to An; see Fig. 6	[4]				
		V_{CC} = 2.3 V to 2.7 V	[2]	1.0	2.8	5.1	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	1.0	3.0	4.2	ns
		V_{CC} = 2.7 V		-	3.0	4.6	ns
		LEAB, LEBA to Bn, An; see Fig. 8					
		V_{CC} = 2.3 V to 2.7 V	[2]	1.1	3.5	6.1	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	1.3	3.4	4.8	ns
		V_{CC} = 2.7 V		-	3.6	5.3	ns
		CPAB, CPBA to Bn, An; see Fig. 8					
		V_{CC} = 2.3 V to 2.7 V	[2]	1.0	3.3	6.1	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	1.4	3.3	4.9	ns
		V_{CC} = 2.7 V		-	3.4	5.6	ns
t_{en}	enable time	$\overline{OEBA}$ to An; see Fig. 7	[4]				
		V_{CC} = 2.3 V to 2.7 V	[2]	1.3	2.8	6.3	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	1.1	2.5	5.0	ns
		V_{CC} = 2.7 V		-	3.3	6.0	ns
		OEAB to Bn; see Fig. 7					
		V_{CC} = 2.3 V to 2.7 V	[2]	1.0	2.5	5.8	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	1.0	2.4	4.6	ns
		V_{CC} = 2.7 V		-	2.7	5.3	ns
t_{dis}	disable time	$\overline{OEBA}$ to An; see Fig. 7	[4]				
		V_{CC} = 2.3 V to 2.7 V	[2]	1.3	2.5	5.3	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	1.3	3.1	4.2	ns
		V_{CC} = 2.7 V		-	3.3	4.6	ns
		OEAB to Bn; see Fig. 7					
		V_{CC} = 2.3 V to 2.7 V	[2]	1.5	2.5	6.2	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	1.4	2.9	5.0	ns
		V_{CC} = 2.7 V		-	3.6	5.7	ns

Symbol	Parameter	Conditions		Min	Typ [1]	Max	Unit
t_W	pulse width	LEAB, LEBA HIGH; see Fig. 8					
		V_{CC} = 2.3 V to 2.7 V	[2]	3.3	0.8	-	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	3.3	0.9	-	ns
		V_{CC} = 2.7 V		3.3	0.7	-	ns
		CPAB, CPBA HIGH or LOW; see Fig. 8					
		V_{CC} = 2.3 V to 2.7 V	[2]	3.3	2.0	-	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	3.3	1.1	-	ns
		V_{CC} = 2.7 V		3.3	1.4	-	ns
t_{su}	set-up time	An, Bn to CPAB, CPBA; see Fig. 9					
		V_{CC} = 2.3 V to 2.7 V	[2]	1.7	0.1	-	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	1.3	-0.3	-	ns
		V_{CC} = 2.7 V		1.4	-0.1	-	ns
		An, Bn to LEAB, LEBA; see Fig. 9					
		V_{CC} = 2.3 V to 2.7 V	[2]	1.1	0.1	-	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	1.0	0.3	-	ns
		V_{CC} = 2.7 V		1.0	-0.2	-	ns
t_h	hold time	An, Bn to CPAB, CPBA; see Fig. 9					
		V_{CC} = 2.3 V to 2.7 V	[2]	1.7	0.3	-	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	1.3	0.4	-	ns
		V_{CC} = 2.7 V		1.6	0.3	-	ns
		An, Bn to LEAB, LEBA; see Fig. 9					
		V_{CC} = 2.3 V to 2.7 V	[2]	1.6	0.3	-	ns
		V_{CC} = 3.0 V to 3.6 V	[3]	1.2	0.1	-	ns
		V_{CC} = 2.7 V		1.5	0.1	-	ns
C_{PD}	power dissipation capacitance	per buffer; V_I = GND to V_{CC}	[5]				
		outputs enabled		-	21	-	pF
		outputs disabled		-	3	-	pF

[1] All typical values are measured at T_{amb} = 25 °C.
[2] Typical values are measured at V_{CC} = 2.5 V.
[3] Typical values are measured at V_{CC} = 3.3 V.
[4] t_{pd} is the same as t_{PLH} and t_{PHL}.
t_{en} is the same as t_{PZL} and t_{PZH}.
t_{dis} is the same as t_{PLZ} and t_{PHZ}.
[5] 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 outputs.

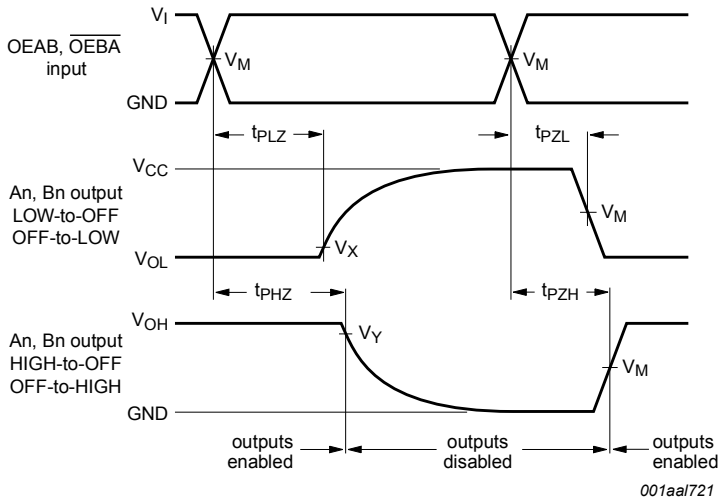
10.1. Waveforms and test circuit



Measurement points are given in Table 8.

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

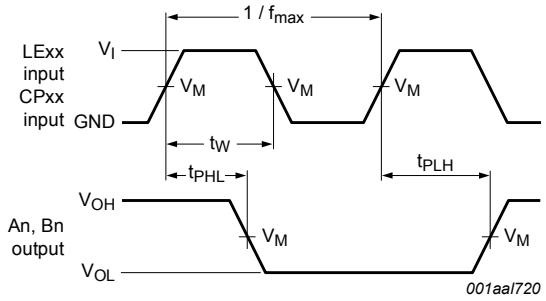
Fig. 6. Propagation delay, data input (An, Bn) to data output (Bn, An)



Measurement points are given in Table 8.

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

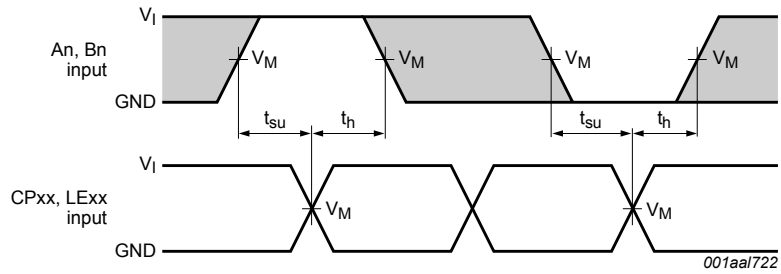
Fig. 7. 3-state output enable and disable times



Measurement points are given in Table 8.

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

Fig. 8. Propagation delay, latch enable input (LEAB, LEBA) and clock pulse input (CPAB, CPBA) to data output, and pulse width

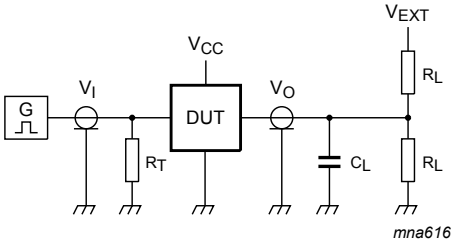


Measurement points are given in Table 8.

Fig. 9. Data set-up and hold times (An, Bn inputs to LEAB, LEBA, CPAB and CPBA inputs)

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 and < 2.3 V	V_{CC}	0.5 × V_{CC}	0.5 × V_{CC}	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_L = Load resistance.

C_L = Load capacitance includes jig and probe capacitance.

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

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

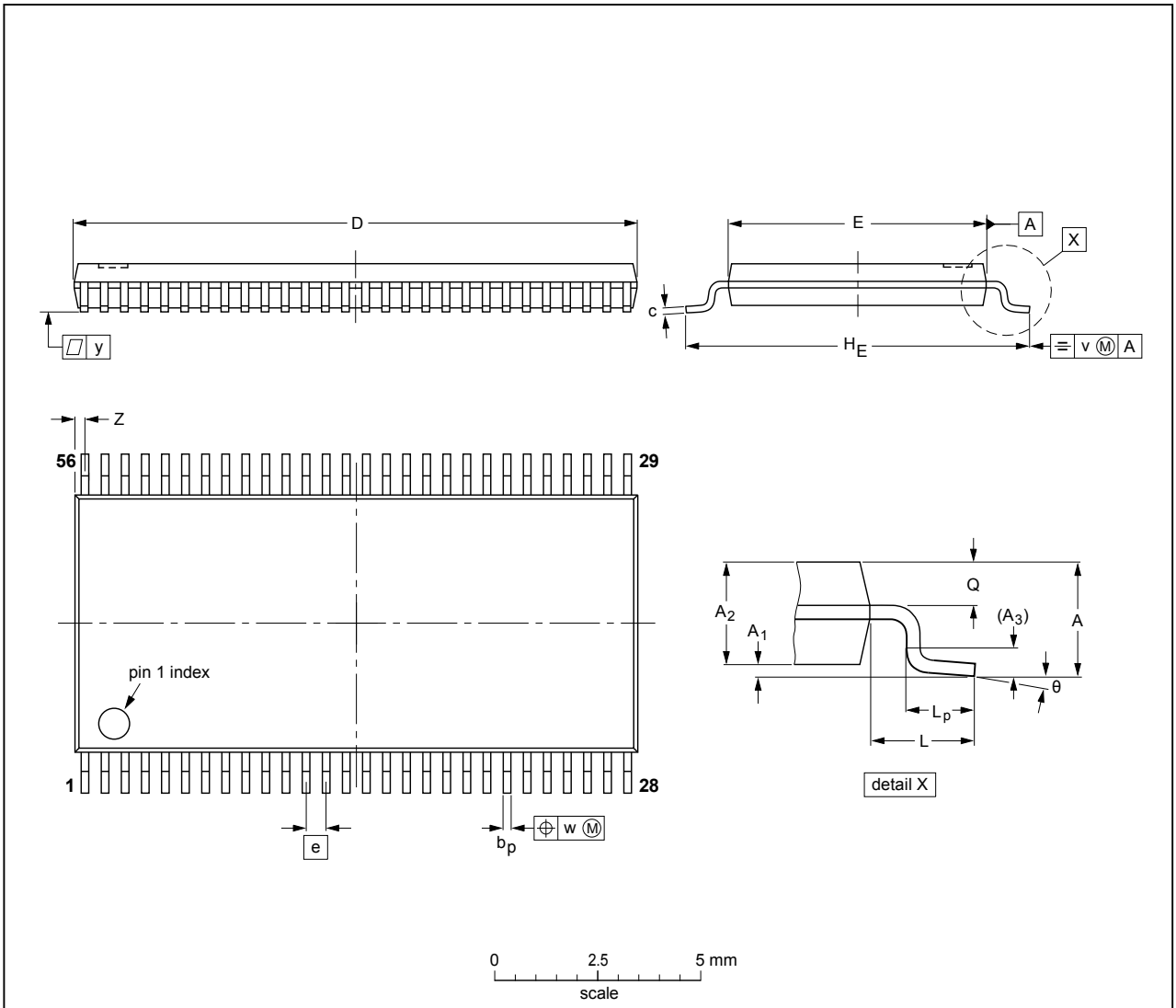
Fig. 10. Test circuit for measuring switching times

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^o 0^o

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. 11. 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
74ALVCH16501 v.6	20190313	Product data sheet	-	74ALVCH16501 v.5
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. • Type numbers 74ALVCH16501DL (SOT371-1) removed.			
74ALVCH16501 v.5	20120710	Product data sheet	-	74ALVCH16501 v.4
Modifications:	• Table 8 corrected (errata).			
74ALVCH16501 v.4	20111117	Product data sheet	-	74ALVCH16501 v.3
Modifications:	• Legal pages updated.			
74ALVCH16501 v.3	20100402	Product data sheet	-	74ALVCH16501 v.2
74ALVCH16501 v.2	19980929	Product specification	-	74ALVCH16501 v.1
74ALVCH16501 v.1	19980929	Product 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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