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# DATA SHEET

**74ALVCH16601**

**18-bit universal bus transceiver (3-State)**

Product specification  
Supersedes data of 1998 Aug 31  
IC24 Data Handbook

1998 Sep 24

## 18-bit universal bus transceiver (3-State)

## 74ALVCH16601

### FEATURES

- Complies with JEDEC standard no. 8-1A
- CMOS low power consumption
- Direct interface with TTL levels
- MULTIBYTE™ flow-through standard pin-out architecture
- Low inductance multiple  $V_{CC}$  and ground pins for minimum noise and ground bounce
- Current drive  $\pm 24$  mA at 3.0 V
- All inputs have bus hold circuitry
- Output drive capability 50 $\Omega$  transmission lines @ 85°C

### DESCRIPTION

The 74ALVCH16601 is an 18-bit universal 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 ( $\overline{OE}_{AB}$  and  $\overline{OE}_{BA}$ ), latch enable ( $LE_{AB}$  and  $LE_{BA}$ ), and clock ( $CP_{AB}$  and  $CP_{BA}$ ) inputs. For A-to-B data flow, the device operates in the transparent mode when  $LE_{AB}$  is High. When  $LE_{AB}$  is Low, the A data is latched if  $CP_{AB}$  is held at a High or Low logic level. If  $LE_{AB}$  is Low, the A-bus data is stored in the latch/flip-flop on the Low-to-High transition of  $CP_{AB}$ . When  $\overline{OE}_{AB}$  is Low, the outputs are active. When  $\overline{OE}_{AB}$  is High, the outputs are in the high-impedance state. The clocks can be controlled with the clock-enable inputs ( $\overline{CE}_{BA}/\overline{CE}_{AB}$ ).

Data flow for B-to-A is similar to that of A-to-B but uses  $\overline{OE}_{BA}$ ,  $LE_{BA}$  and  $CP_{BA}$ .

To ensure the high impedance state during power up or power down,  $\overline{OE}_{BA}$  and  $\overline{OE}_{AB}$  should be tied to  $V_{CC}$  through a pullup 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.

### QUICK REFERENCE DATA

GND = 0V;  $T_{amb} = 25^\circ\text{C}$ ;  $t_r = t_f = 2.5$  ns

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT	
$t_{PHL}/t_{PLH}$	Propagation delay An, Bn to Bn, An	$V_{CC} = 2.5\text{V}, C_L = 30\text{pF}$ $V_{CC} = 3.3\text{V}, C_L = 50\text{pF}$	3.1 2.8	ns	
$C_{I/O}$	Input/Output capacitance		8.0	pF	
$C_I$	Input capacitance		4.0	pF	
$C_{PD}$	Power dissipation capacitance per latch	$V_I = \text{GND to } V_{CC}^1$	Outputs enabled	21	pF
			Outputs disabled	3	

#### NOTES:

1.  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ):

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

$f_i$  = input frequency in MHz;  $C_L$  = output load capacity in pF;

$f_o$  = output frequency in MHz;  $V_{CC}$  = supply voltage in V;

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

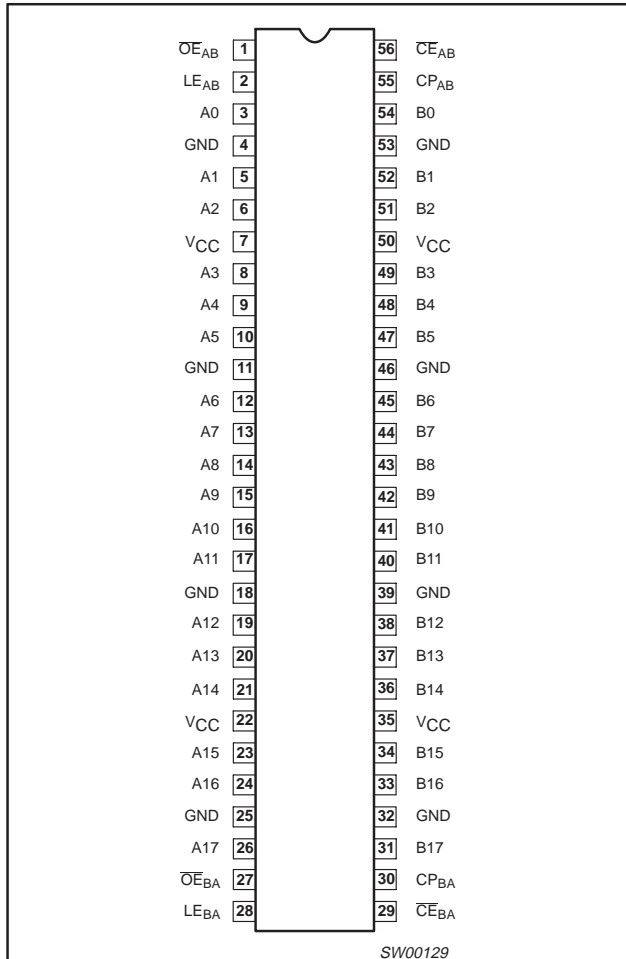
### ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	DWG NUMBER
56-Pin Plastic TSSOP Type II	-40°C to +85°C	74ALVCH16601 DGG	SOT364-1

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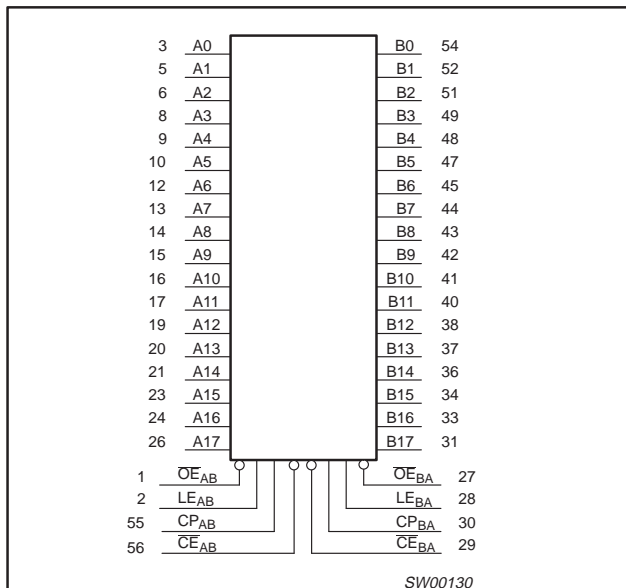
**PIN CONFIGURATION**



**PIN DESCRIPTION**

PIN NUMBER	SYMBOL	NAME AND FUNCTION
1	$\overline{OE}_{AB}$	Output enable A-to-B
2	$LE_{AB}$	Latch enable A-to-B
3, 5, 6, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 21, 23, 24, 26	A0 to A17	Data inputs/outputs
4, 11, 18, 25, 32, 39, 46, 53	GND	Ground (0V)
7, 22, 35, 50	$V_{CC}$	Positive supply voltage
27	$\overline{OE}_{BA}$	Output enable B-to-A
28	$LE_{BA}$	Latch enable B-to-A
29	$\overline{CE}_{BA}$	Clock enable B-to-A
30	$CP_{BA}$	Clock input B-to-A
54, 52, 51, 49, 48, 47, 45, 44, 43, 42, 41, 40, 38, 37, 36, 34, 33, 31	B0 to B17	Data inputs/outputs
55	$CP_{AB}$	Clock input A-to-B
56	$\overline{CE}_{AB}$	Clock enable A-to-B

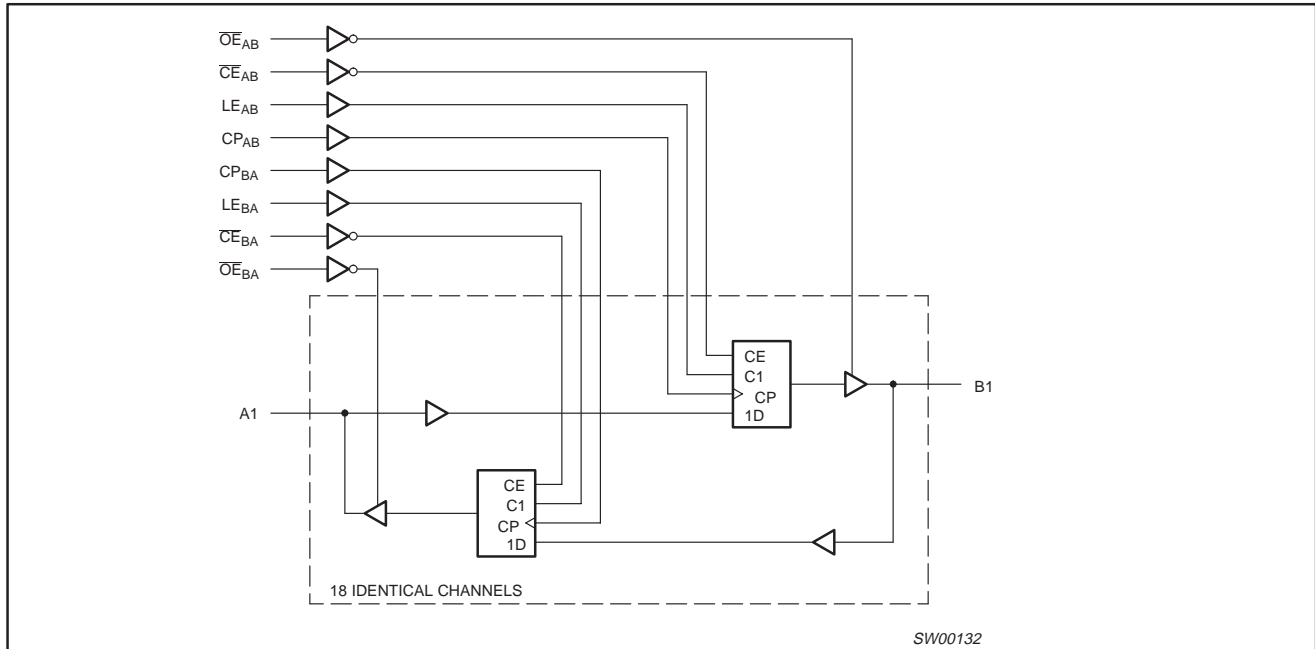
**LOGIC SYMBOL**



18-bit universal bus transceiver (3-State)

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LOGIC DIAGRAM (one section)



FUNCTION TABLE

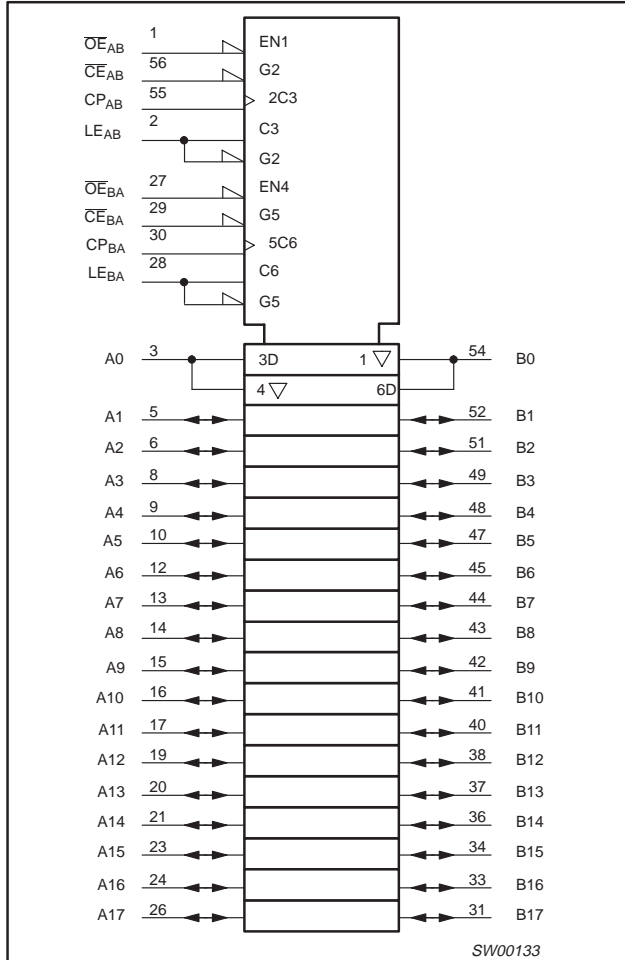
INPUTS					OUTPUTS	STATUS
CE <sub>XX</sub>	OE <sub>XX</sub>	LE <sub>XX</sub>	CP <sub>XX</sub>	DATA		
X	H	X	X	X	Z	Disabled
X	L	H	X	H	H	Transparent
X	L	H	X	L	L	
H	L	L	X	X	NC	Hold
L	L	L	↑	h	H	Clock + display
L	L	L	↑	l	L	
L	L	L	L	X	NC	Hold
L	L	L	H	X		

- XX = AB for A-to-B direction, BA for B-to-A direction
- H = HIGH voltage level
- L = LOW voltage level
- h = HIGH state must be present one setup time before the LOW-to-HIGH transition of CP<sub>XX</sub>
- l = LOW state must be present one setup time before the LOW-to-HIGH transition of CP<sub>XX</sub>
- X = Don't care
- ↑ = LOW-to-HIGH level transition
- NC = No change
- Z = High impedance "off" state

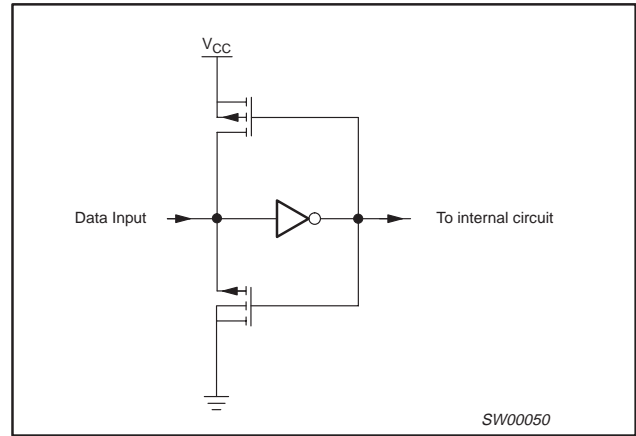
18-bit universal bus transceiver (3-State)

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LOGIC SYMBOL (IEEE/IEC)



BUSHOLD CIRCUIT



18-bit universal bus transceiver (3-State)

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RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	LIMITS		UNIT
			MIN	MAX	
V <sub>CC</sub>	DC supply voltage 2.5V range (for max. speed performance @ 30 pF output load)		2.3	2.7	V
	DC supply voltage 3.3V range (for max. speed performance @ 50 pF output load)		3.0	3.6	
V <sub>I</sub>	DC Input voltage range		0	V <sub>CC</sub>	V
V <sub>O</sub>	DC output voltage range		0	V <sub>CC</sub>	V
T <sub>amb</sub>	Operating free-air temperature range		-40	+85	°C
t <sub>r</sub> , t <sub>f</sub>	Input rise and fall times	V <sub>CC</sub> = 2.3 to 3.0V V <sub>CC</sub> = 3.0 to 3.6V	0 0	20 10	ns/V

ABSOLUTE MAXIMUM RATINGS

In accordance with the Absolute Maximum Rating System (IEC 134)

Voltages are referenced to GND (ground = 0V)

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
V <sub>CC</sub>	DC supply voltage		-0.5 to +4.6	V
I <sub>IK</sub>	DC input diode current	V <sub>I</sub> < 0	-50	mA
V <sub>I</sub>	DC input voltage	For control pins <sup>1</sup>	-0.5 to +4.6	V
		For data inputs <sup>1</sup>	-0.5 to V <sub>CC</sub> +0.5	
I <sub>OK</sub>	DC output diode current	V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0	± 50	mA
V <sub>O</sub>	DC output voltage	Note 1	-0.5 to V <sub>CC</sub> +0.5	V
I <sub>O</sub>	DC output source or sink current	V <sub>O</sub> = 0 to V <sub>CC</sub>	± 50	mA
I <sub>GND</sub> , I <sub>CC</sub>	DC V <sub>CC</sub> or GND current		± 100	mA
T <sub>stg</sub>	Storage temperature range		-65 to +150	°C
P <sub>TOT</sub>	Power dissipation per package -plastic thin-medium-shrink (TSSOP)	For temperature range: -40 to +125 °C above +55°C derate linearly with 8 mW/K	600	mW

NOTE:

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

## 18-bit universal bus transceiver (3-State)

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**DC ELECTRICAL CHARACTERISTICS**

Over recommended operating conditions. Voltage are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			Temp = -40°C to +85°C			
			MIN	TYP <sup>1</sup>	MAX	
V <sub>IH</sub>	HIGH level Input voltage	V <sub>CC</sub> = 2.3 to 2.7V	1.7	1.2		V
		V <sub>CC</sub> = 2.7 to 3.6V	2.0	1.5		
V <sub>IL</sub>	LOW level Input voltage	V <sub>CC</sub> = 2.3 to 2.7V		1.2	0.7	V
		V <sub>CC</sub> = 2.7 to 3.6V		1.5	0.8	
V <sub>OH</sub>	HIGH level output voltage	V <sub>CC</sub> = 2.3 to 3.6V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -100μA	V <sub>CC</sub> - 0.2	V <sub>CC</sub>		V
		V <sub>CC</sub> = 2.3V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -6mA	V <sub>CC</sub> - 0.3	V <sub>CC</sub> - 0.08		
		V <sub>CC</sub> = 2.3V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -12mA	V <sub>CC</sub> - 0.6	V <sub>CC</sub> - 0.26		
		V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -12mA	V <sub>CC</sub> - 0.5	V <sub>CC</sub> - 0.14		
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -12mA	V <sub>CC</sub> - 0.6	V <sub>CC</sub> - 0.09		
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -24mA	V <sub>CC</sub> - 1.0	V <sub>CC</sub> - 0.28		
V <sub>OL</sub>	LOW level output voltage	V <sub>CC</sub> = 2.3 to 3.6V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 100μA		GND	0.20	V
		V <sub>CC</sub> = 2.3V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 6mA		0.07	0.40	V
		V <sub>CC</sub> = 2.3V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 12mA		0.15	0.70	V
		V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 12mA		0.14	0.40	
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 24mA		0.27	0.55	
I <sub>I</sub>	Input leakage current	V <sub>CC</sub> = 2.3 to 3.6V; V <sub>I</sub> = V <sub>CC</sub> or GND		0.1	5	μA
I <sub>OZ</sub>	3-State output OFF-state current	V <sub>CC</sub> = 2.7 to 3.6V; 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>	Quiescent supply current	V <sub>CC</sub> = 2.3 to 3.6V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0		0.2	40	μA
ΔI <sub>CC</sub>	Additional quiescent supply current	V <sub>CC</sub> = 2.3V to 3.6V; V <sub>I</sub> = V <sub>CC</sub> - 0.6V; I <sub>O</sub> = 0		150	750	μA
I <sub>BHL</sub>	Bus hold LOW sustaining current	V <sub>CC</sub> = 2.3V; V <sub>I</sub> = 0.7V <sup>2</sup>	45	-		μA
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = 0.8V <sup>2</sup>	75	150		
I <sub>BHH</sub>	Bus hold HIGH sustaining current	V <sub>CC</sub> = 2.3V; V <sub>I</sub> = 1.7V <sup>2</sup>	-45			μA
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = 2.0V <sup>2</sup>	-75	-175		
I <sub>BHLO</sub>	Bus hold LOW overdrive current	V <sub>CC</sub> = 3.6V <sup>2</sup>	500			μA
I <sub>BHHO</sub>	Bus hold HIGH overdrive current	V <sub>CC</sub> = 3.6V <sup>2</sup>	-500			μA

**NOTES:**

1. All typical values are at T<sub>amb</sub> = 25°C.
2. Valid for data inputs of bus hold parts.



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**AC CHARACTERISTICS FOR  $V_{CC} = 2.3V$  TO  $2.7V$  RANGE**

GND = 0V;  $t_r = t_f \leq 2.0ns$ ;  $C_L = 30pF$

SYMBOL	PARAMETER	WAVEFORM	LIMITS			UNIT
			$V_{CC} = 2.5V \pm 0.2V$			
			MIN	TYP <sup>1</sup>	MAX	
$t_{PHL}/t_{PLH}$	Propagation delay An, Bn to Bn, An	1, 2	1.0	3.1	5.2	ns
	Propagation delay LE <sub>AB</sub> , LE <sub>BA</sub> to Bn, An		1.0	3.6	6.2	
	Propagation delay CP <sub>AB</sub> , CP <sub>BA</sub> to Bn, An		1.0	3.4	5.9	
$t_{PZH}/t_{PZL}$	3-State output enable time OE <sub>BA</sub> , OE <sub>AB</sub> to An,Bn	3	1.1	3.1	5.3	ns
$t_{PHZ}/t_{PLZ}$	3-State output enable time OE <sub>BA</sub> , OE <sub>AB</sub> to An,Bn	3	1.4	2.8	4.9	ns
$t_w$	Pulse width HIGH LE <sub>AB</sub> or LE <sub>BA</sub>	2	3.3	1.6	–	ns
	Pulse width HIGH or LOW CP <sub>AB</sub> , CP <sub>BA</sub>		3.3	2.0	–	
$t_{SU}$	Set-up time An, Bn to CP <sub>AB</sub> , CP <sub>BA</sub>	4	2.3	–0.2	–	ns
	Set-up time An, Bn to LE <sub>AB</sub> , LE <sub>BA</sub>		1.3	0.1	–	
	Set-up time CE <sub>AB</sub> , CE <sub>BA</sub> to CP <sub>AB</sub> , CP <sub>BA</sub>		2.0	–0.4	–	
$t_h$	Hold time An, Bn to CP <sub>AB</sub> , CP <sub>BA</sub>	4	1.2	0.3	–	ns
	Hold time An, Bn to LE <sub>AB</sub> , LE <sub>BA</sub>		1.3	0.2	–	
	Hold time CE <sub>AB</sub> , CE <sub>BA</sub> to CP <sub>AB</sub> , CP <sub>BA</sub>		1.1	0.4	–	
$f_{MAX}$	Maximum clock frequency		150	390	–	MHz

**NOTE:**

1. All typical values are at  $V_{CC} = 2.5V$  and  $T_{amb} = 25^\circ C$ .

## 18-bit universal bus transceiver (3-State)

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**AC CHARACTERISTICS FOR  $V_{CC} = 3.0V$  TO  $3.6V$  RANGE AND  $V_{CC} = 2.7V$** 

 GND = 0V;  $t_r = t_f = 2.5ns$ ;  $C_L = 50pF$ 

SYMBOL	PARAMETER	WAVEFORM	LIMITS						UNIT
			$V_{CC} = 3.3V \pm 0.3V$			$V_{CC} = 2.7V$			
			MIN	TYP <sup>1</sup>	MAX	MIN	TYP	MAX	
$t_{PHL}/t_{PLH}$	Propagation delay An, Bn to Bn, An	1, 2	1.0	2.8	4.2		3.1	4.7	ns
	Propagation delay LE <sub>AB</sub> , LE <sub>BA</sub> to Bn, An		1.0	3.1	4.9		3.4	5.4	
	Propagation delay CP <sub>AB</sub> , CP <sub>BA</sub> to Bn, An		1.3	3.1	5.0		3.5	5.8	
$t_{PZH}/t_{PZL}$	3-State output enable time OE <sub>BA</sub> to An	3	1.1	2.8	5.2		3.3	6.1	ns
$t_{PHZ}/t_{PLZ}$	3-State output disable time OE <sub>BA</sub> to An	3	1.2	3.2	4.4		3.3	4.8	ns
$t_W$	LE pulse width LE <sub>AB</sub> , LE <sub>BA</sub> to CP <sub>AB</sub> , CP <sub>BA</sub>	2	3.3	0.9		3.3	0.7		ns
	LE pulse width HIGH or LOW CP <sub>AB</sub> , CP <sub>BA</sub>		3.3	0.9		3.3	1.2		
$t_{SU}$	Set-up time An, Bn to CP <sub>AB</sub> , CP <sub>BA</sub>	4	2.1	-0.2		2.4	0.0		ns
	Set-up time An, Bn to LE <sub>AB</sub> , LE <sub>BA</sub>		1.1	0.3		1.2	-0.2		
	Set-up time CE <sub>AB</sub> , CE <sub>BA</sub> to CP <sub>AB</sub> , CP <sub>BA</sub>		1.7	-0.2		2.0	-0.7		
$t_H$	Hold time An, Bn to CP <sub>AB</sub> , CP <sub>BA</sub>	4	1.0	-0.1		1.1	0.3		ns
	Hold time An, Bn to LE <sub>AB</sub> , LE <sub>BA</sub>		1.4	0.1		1.6	0.1		
	Hold time CE <sub>AB</sub> , CE <sub>BA</sub> to CP <sub>AB</sub> , CP <sub>BA</sub>		1.1	0.4		1.2	0.6		
$f_{MAX}$	Maximum clock frequency		150	340		150	333		MHz

**NOTE:**

 1. All typical values are at  $V_{CC} = 3.3V$  and  $T_{amb} = 25^\circ C$ .

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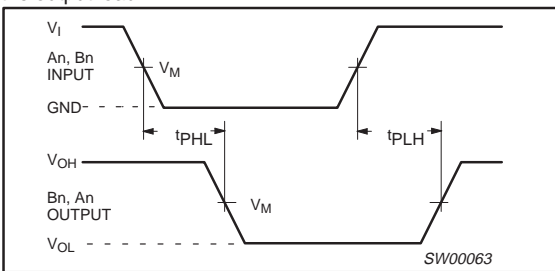
**AC WAVEFORMS**

**V<sub>CC</sub> = 2.3 TO 2.7 V RANGE**

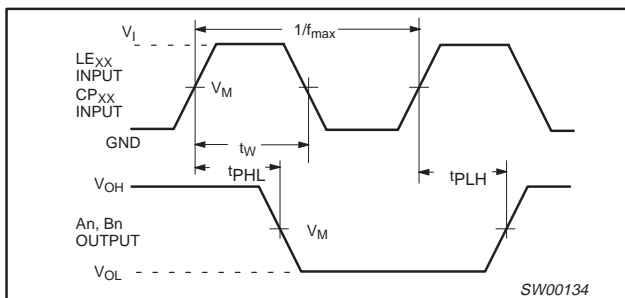
1.  $V_M = 0.5 V$
2.  $V_X = V_{OL} + 0.15V$
3.  $V_Y = V_{OH} - 0.15V$
4.  $V_I = V_{CC}$
5.  $V_{OL}$  and  $V_{OH}$  are the typical output voltage drop that occur with the output load.

**V<sub>CC</sub> = 3.0 TO 3.6 V RANGE AND V<sub>CC</sub> = 2.7 V**

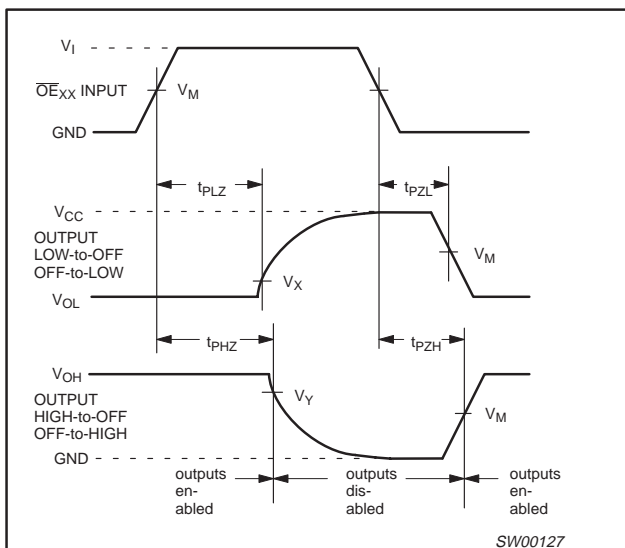
1.  $V_M = 1.5 V$
2.  $V_X = V_{OL} + 0.3V$
3.  $V_Y = V_{OH} - 0.3V$
4.  $V_I = 2.7 V$
5.  $V_{OL}$  and  $V_{OH}$  are the typical output voltage drop that occur with the output load.



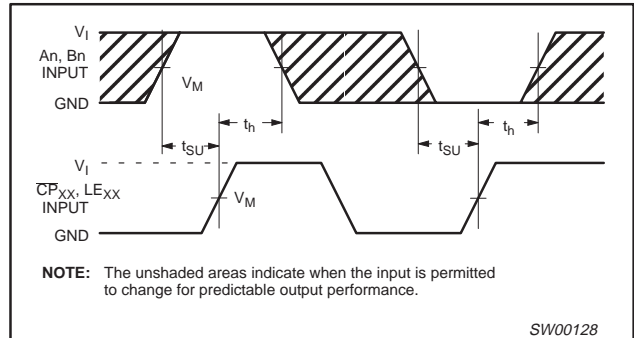
Waveform 1. Input (An, Bn) to output (Bn, An) propagation delays



Waveform 2. Latch enable input (LE<sub>AB</sub>, LE<sub>BA</sub>) and clock pulse input (CP<sub>AB</sub>, CP<sub>BA</sub>) to output propagation delays and their pulse width

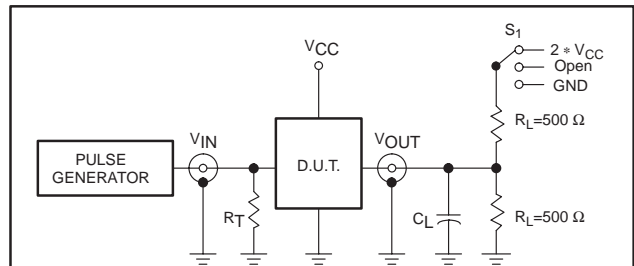


Waveform 3. 3-State enable and disable times



Waveform 4. Data set-up and hold times for the An and Bn inputs to the LE<sub>AB</sub>, LE<sub>BA</sub>, CP<sub>AB</sub> and CP<sub>BA</sub> inputs

**TEST CIRCUIT**



Test Circuit for 3-State Outputs

**SWITCH POSITION**

TEST	SWITCH
t <sub>PLH</sub> /t <sub>PHL</sub>	Open
t <sub>PLZ</sub> /t <sub>PZL</sub>	2 * V <sub>CC</sub>
t <sub>PHZ</sub> /t <sub>PZH</sub>	GND

V <sub>CC</sub>	V <sub>IN</sub>
< 2.7V	V <sub>CC</sub>
2.7 – 3.6V	2.7V

**DEFINITIONS**

- $R_L$  = Load resistor
- $C_L$  = Load capacitance includes jig and probe capacitance
- $R_T$  = Termination resistance should be equal to  $Z_{OUT}$  of pulse generators.

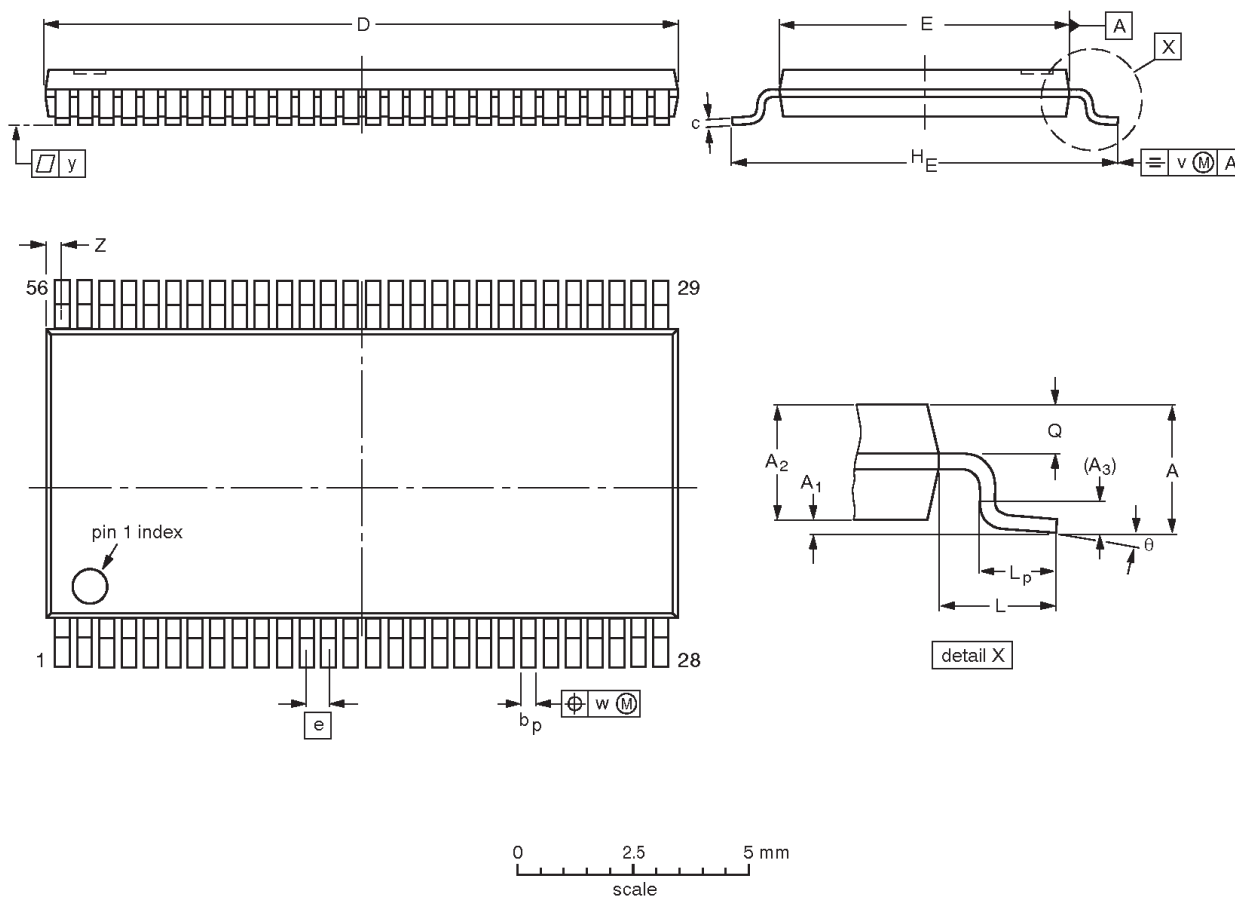
Load circuitry for switching times

18-bit universal bus transceiver (3-State)

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

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	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	EIAJ			
SOT364-1		MO-153EE				93-02-03 95-02-10

18-bit universal bus transceiver (3-State)

74ALVCH16601

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Data Sheet Identification	Product Status	Definition
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Date of release: 06-98

Document order number:

9397-750-04798

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