

DATA SHEET

74ABT16501A

18-bit universal bus transceiver (3-State)

Product data

2002 Apr 03

Replaces 74ABT16501A/74ABTH16501A dated 1998 Feb 27

18-bit universal bus transceiver (3-State)

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FEATURES

- 18-bit bidirectional bus interface
- 3-State buffers
- Output capability: +64 mA/−32 mA
- TTL input and output switching levels
- Live insertion/extraction permitted
- Power-up reset
- Power-up 3-State
- Positive edge-triggered clock inputs
- Latch-up protection exceeds 500mA per JEDEC Std 17
- ESD protection exceeds 2000 V per MIL STD 883 Method 3015 and 200 V per Machine Model
- Flexible operation permits 18 embedded D-type latches or flip-flops to operate in clocked, transparent, and latched modes.

DESCRIPTION

The 74ABT16501A high-performance BiCMOS device combines low static and dynamic power dissipation with high speed and high output drive.

This device 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 (OEAB and 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 OEBA, LEBA and CPBA. The output enables are complimentary (OEAB is Active-HIGH, and OEBA is Active-LOW).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS $T_{amb} = 25\text{ }^{\circ}\text{C}; \text{GND} = 0\text{ V}$	TYPICAL	UNIT
t_{PLH} t_{PHL}	Propagation delay An to Bn or Bn to An	$C_L = 50\text{ pF};$ $V_{CC} = 5\text{ V}$	2.2 1.8	ns
C_{IN}	Input capacitance (Control pins)	$V_I = 0\text{ V}$ or V_{CC}	3	pF
$C_{I/O}$	I/O pin capacitance	Outputs disabled; $V_{I/O} = 0\text{ V}$ or V_{CC}	7	pF
I_{CCZ}	Quiescent supply current	Outputs disabled; $V_{CC} = 5.5\text{ V}$	500	μA
I_{CCL}		Outputs LOW; $V_{CC} = 5.5\text{ V}$	9	mA

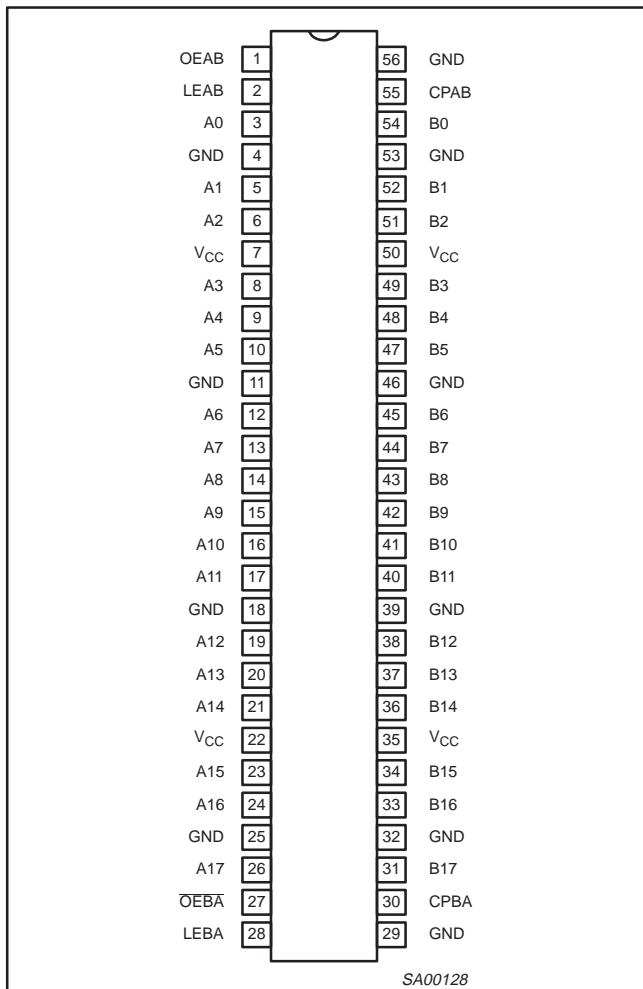
ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	ORDER CODE	DWG NUMBER
56-Pin Plastic SSOP Type III	−40 °C to +85 °C	74ABT16501ADL	SOT371-1
56-Pin Plastic TSSOP Type II	−40 °C to +85 °C	74ABT16501ADGG	SOT364-1

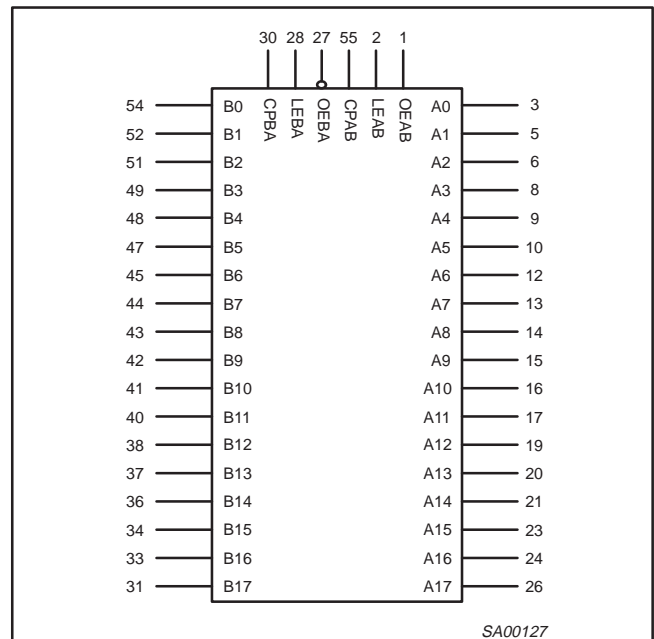
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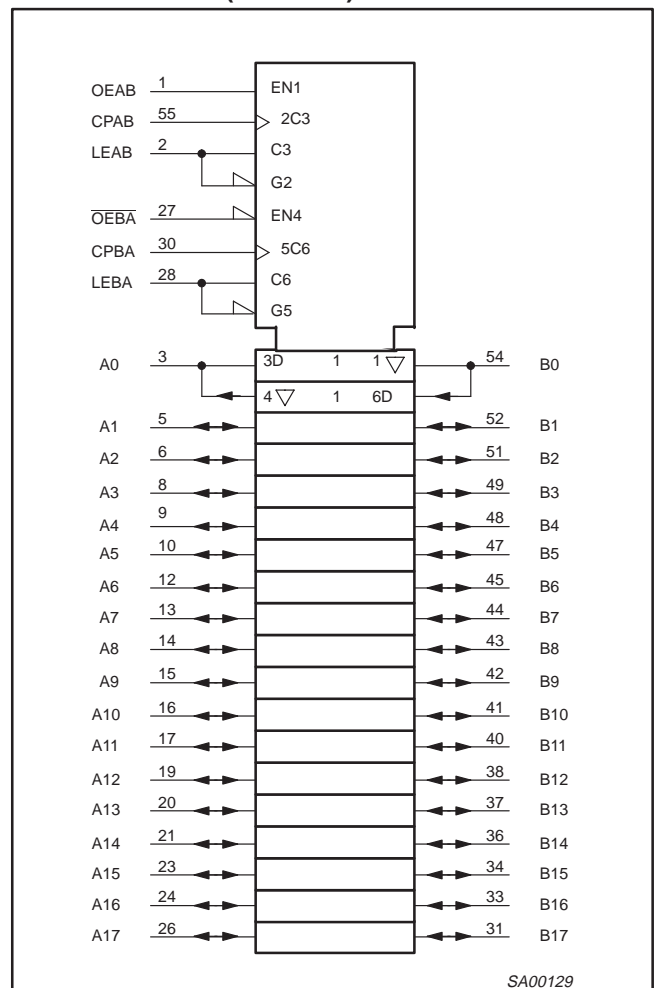
PIN CONFIGURATION



LOGIC SYMBOL



LOGIC SYMBOL (IEEE/IEC)



PIN DESCRIPTION

PIN NUMBER	SYMBOL	NAME AND FUNCTION
1	OEAB	A-to-B Output enable input
27	OEBA	B-to-A Output enable input (Active-LOW)
2, 28	LEAB/LEBA	A-to-B/B-to-A Latch enable input
55, 30	CPAB/CPBA	A-to-B/B-to-A Clock input (active rising edge)
3, 5, 6, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 21, 23, 24, 26	A0-A17	Data inputs/outputs (A side)
54, 52, 51, 49, 48, 47, 45, 44, 43, 42, 41, 40, 38, 37, 36, 34, 33, 31	B0-B17	Data inputs/outputs (B side)
4, 11, 18, 25, 32, 39, 46, 53	GND	Ground (0 V)
7, 22, 35, 50	V _{CC}	Positive supply voltage

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FUNCTION TABLE

INPUTS				Internal Registers	OUTPUTS	OPERATING MODE
OEAB	LEAB	CPAB	An		Bn	
L	H	X	X	X	Z	Disabled
L	↓	X	h	H	Z	Disabled, Latch data
L	↓	X	l	L	Z	
L	L	H or L	X	NC	Z	Disabled, Hold data
L	L	↑	h	H	Z	Disabled, Clock data
L	L	↑	l	L	Z	
H	H	X	H	H	H	Transparent
H	H	X	L	L	L	
H	↓	X	h	H	H	Latch data & display
H	↓	X	l	L	L	
H	L	↑	h	H	H	Clock data & display
H	L	↑	l	L	L	
H	L	H or L	X	H	H	Hold data & display
H	L	H or L	X	L	L	

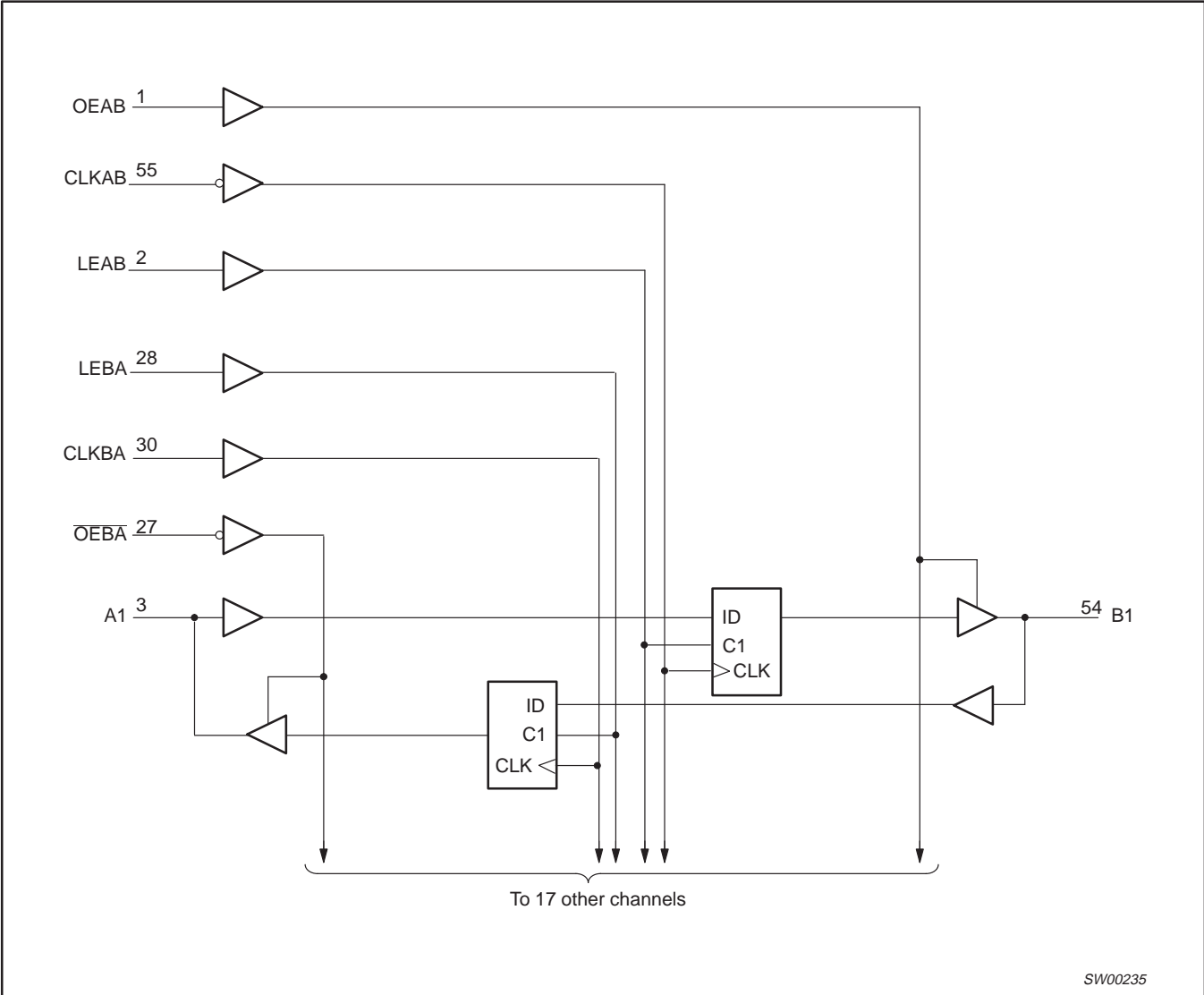
NOTE: A-to-B data flow is shown; B-to-A flow is similar but uses OEBA, LEBA, and CPBA.

- 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
- NC= No Change
- X = Don't care
- Z = High Impedance "off" state
- ↓ = HIGH-to-LOW Enable or Clock transition
- ↑ = LOW-to-HIGH Clock transition

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LOGIC DIAGRAM



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ABSOLUTE MAXIMUM RATINGS^{1, 2}

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
V _{CC}	DC supply voltage		-0.5 to +7.0	V
I _{IK}	DC input diode current	V _I < 0 V	-18	mA
V _I	DC input voltage ³		-1.2 to +7.0	V
I _{OK}	DC output diode current	V _O < 0 V	-50	mA
V _{OUT}	DC output voltage ³	Output in Off or HIGH state	-0.5 to +5.5	V
I _{OUT}	DC output current	Output in LOW state	128	mA
		Output in HIGH state	-64	
T _{stg}	Storage temperature range		-65 to +150	°C

NOTES:

- Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150 °C.
- The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS		UNIT
		MIN	MAX	
V _{CC}	DC supply voltage	4.5	5.5	V
V _I	Input voltage	0	V _{CC}	V
V _{IH}	HIGH-level input voltage	2.0	-	V
V _{IL}	Input voltage	-	0.8	V
I _{OH}	HIGH-level output current	-	-32	mA
I _{OL}	LOW-level output current	-	64	mA
Δt/Δv	Input transition rise or fall rate; Outputs enabled	-	10	ns/V
T _{amb}	Operating free-air temperature range	-40	+85	°C

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DC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS					UNIT	
			T _{amb} = +25 °C			T _{amb} = -40 °C to +85 °C			
			MIN	TYP	MAX	MIN	MAX		
V _{IK}	Input clamp voltage	V _{CC} = 4.5 V; I _{IK} = -18 mA	-	-0.8	-1.2	-	-1.2	V	
V _{OH}	High-level output voltage	V _{CC} = 4.5 V; I _{OH} = -3 mA; V _I = V _{IL} or V _{IH}	2.5	2.9	-	2.5	-	V	
		V _{CC} = 5.0 V; I _{OH} = -3 mA; V _I = V _{IL} or V _{IH}	3.0	4.0	-	3.0	-	V	
		V _{CC} = 4.5 V; I _{OH} = -32 mA; V _I = V _{IL} or V _{IH}	2.0	2.4	-	2.0	-	V	
V _{OL}	Low-level output voltage	V _{CC} = 4.5 V; I _{OL} = 64 mA; V _I = V _{IL} or V _{IH}	-	0.35	0.55	-	0.55	V	
V _{RST}	Power-up output voltage ³	V _{CC} = 5.5 V; I _O = 1 mA; V _I = GND or V _{CC}	-	0.13	0.55	-	0.55	V	
I _I	Input leakage current	V _{CC} = 5.5 V; V _I = GND or 5.5 V	Control pins	-	±0.01	±1.0	-	±1.0	µA
I _{OFF}	Power-off leakage current	V _{CC} = 0.0 V; V _O or V _I ≤ 4.5 V	-	±2	±100	-	±100	µA	
I _{PU/PD}	Power-up/down 3-State output current ⁴	V _{CC} = 2.1 V; V _O = 0.0 V or V _{CC} ; V _I = GND or V _{CC} ; V _{OE} = Don't care	-	±2	±50	-	±50	µA	
I _{IH} + I _{OZH}	3-State output High current	V _{CC} = 5.5 V; V _O = 5.5 V; V _I = V _{IL} or V _{IH}	-	1.0	10	-	10	µA	
I _{IL} + I _{OZL}	3-State output Low current	V _{CC} = 5.5 V; V _O = 0.0 V; V _I = V _{IL} or V _{IH}	-	-1.0	-10	-	-10	µA	
I _{CEX}	Output High leakage current	V _{CC} = 5.5 V; V _O = 5.5 V; V _I = GND or V _{CC}	-	2.0	50	-	50	µA	
I _O	Output current ¹	V _{CC} = 5.5 V; V _O = 2.5 V	-50	-80	-180	-50	-180	mA	
I _{CCH}	Quiescent supply current	V _{CC} = 5.5 V; Outputs HIGH, V _I = GND or V _{CC}	-	0.5	2	-	2	mA	
I _{CCL}		V _{CC} = 5.5 V; Outputs LOW, V _I = GND or V _{CC}	-	9	19	-	19	mA	
I _{CCZ}		V _{CC} = 5.5 V; Outputs 3-State; V _I = GND or V _{CC}	-	0.5	2	-	2	mA	
ΔI _{CC}	Additional supply current per input pin ²	V _{CC} = 5.5 V; one input at 3.4 V, other inputs at V _{CC} or GND	-	5.0	50	-	50	µA	

NOTES:

- Not more than one output should be tested at a time, and the duration of the test should not exceed one second.
- This is the increase in supply current for each input at 3.4 V.
- For valid test results, data must not be loaded into the flip-flops (or latches) after applying the power.
- This parameter is valid for any V_{CC} between 0 V and 2.1 V, with a transition time of up to 10 msec. From V_{CC} = 2.1 V to V_{CC} = 5 V ± 10% a transition time of up to 100 µsec is permitted.

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AC CHARACTERISTICS

GND = 0 V, $t_R = t_F = 2.5 \text{ ns}$, $C_L = 50 \text{ pF}$, $R_L = 500 \Omega$

SYMBOL	PARAMETER	WAVEFORM	LIMITS					UNIT
			$T_{\text{amb}} = +25 \text{ }^\circ\text{C}$ $V_{\text{CC}} = +5.0 \text{ V}$			$T_{\text{amb}} = -40 \text{ }^\circ\text{C to } +85 \text{ }^\circ\text{C}$ $V_{\text{CC}} = +5.0 \text{ V } \pm 0.5 \text{ V}$		
			MIN	TYP	MAX	MIN	MAX	
f_{max}	Maximum clock frequency	1	150	225		150		MHz
t_{PLH} t_{PHL}	Propagation delay An to Bn or Bn to An	2	1.0 1.0	2.2 1.8	3.0 2.5	1.0 1.0	3.5 3.0	ns
t_{PLH} t_{PHL}	Propagation delay LEAB to Bn or LEBA to An	3	1.5 1.4	3.2 2.9	4.3 3.8	1.5 1.4	5.0 4.2	ns
t_{PLH} t_{PHL}	Propagation delay CPAB to Bn or CPBA to An	1	1.6 1.4	3.5 2.9	4.5 3.8	1.6 1.4	5.0 4.2	ns
t_{PZH} t_{PZL}	Output enable time to HIGH and LOW level	5 6	1.1 1.0	3.0 2.4	4.0 3.4	1.1 1.0	4.7 3.9	ns
t_{PHZ} t_{PLZ}	Output disable time from HIGH and LOW level	5 6	1.3 1.0	3.3 2.4	4.3 3.4	1.3 1.0	5.3 3.9	ns

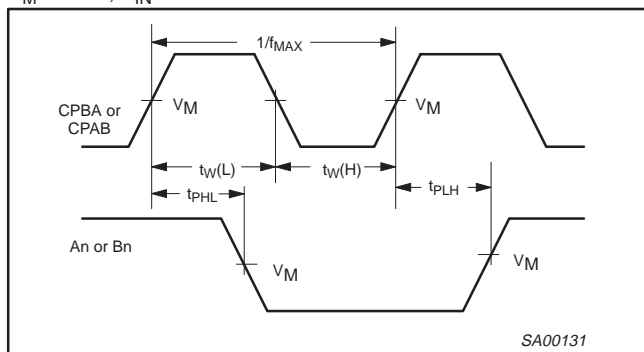
AC SETUP REQUIREMENTS

GND = 0V, $t_R = t_F = 2.5\text{ns}$, $C_L = 50\text{pF}$, $R_L = 500\Omega$

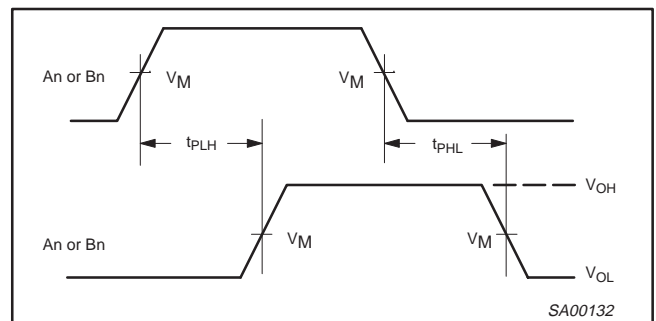
SYMBOL	PARAMETER	WAVEFORM	LIMITS			UNIT
			$T_{\text{amb}} = +25 \text{ }^\circ\text{C}$ $V_{\text{CC}} = +5.0 \text{ V}$		$T_{\text{amb}} = -40 \text{ }^\circ\text{C to } +85 \text{ }^\circ\text{C}$ $V_{\text{CC}} = +5.0 \text{ V } \pm 0.5 \text{ V}$	
			MIN	TYP	MIN	
$t_s(\text{H})$ $t_s(\text{L})$	Setup time, HIGH or LOW An to CPAB or Bn to CPBA	4	2.0 2.0	0.5 0.5	2.0 2.0	ns
$t_h(\text{H})$ $t_h(\text{L})$	Hold time, HIGH or LOW An to CPAB or Bn to CPBA	4	0.7 0.7	-0.5 -0.5	0.7 0.7	ns
$t_s(\text{H})$ $t_s(\text{L})$	Setup time, HIGH or LOW An to LEAB or Bn to LEBA	4	2.0 2.0	0.5 0.4	2.0 2.0	ns
$t_h(\text{H})$ $t_h(\text{L})$	Hold time HIGH or LOW An to LEAB or Bn to LEBA	4	0.7 0.7	-0.4 -0.5	0.7 0.7	ns
t_w	Pulse width, HIGH or LOW CPAB or CPBA	1	3	1.9	3	ns
$t_w(\text{H})$	Pulse width, HIGH LEAB or LEBA	3	3	1.2	3	ns

AC WAVEFORMS

$V_M = 1.5 \text{ V}$, $V_{\text{IN}} = \text{GND to } 3.0 \text{ V}$



Waveform 1. Propagation Delay, Clock Input to Output, Clock Pulse Width, and Maximum Clock Frequency



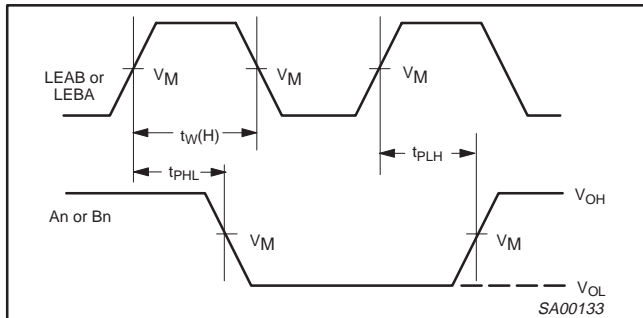
Waveform 2. Propagation Delay, Transparent Mode

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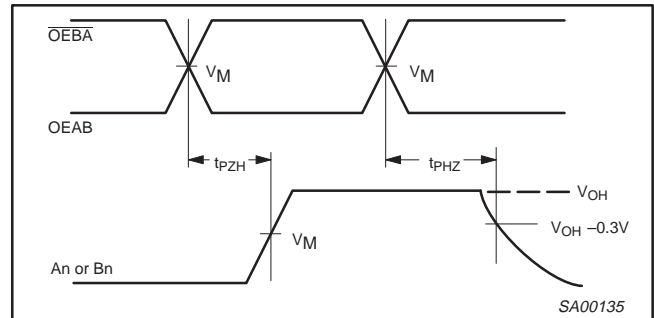
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AC WAVEFORMS (Continued)

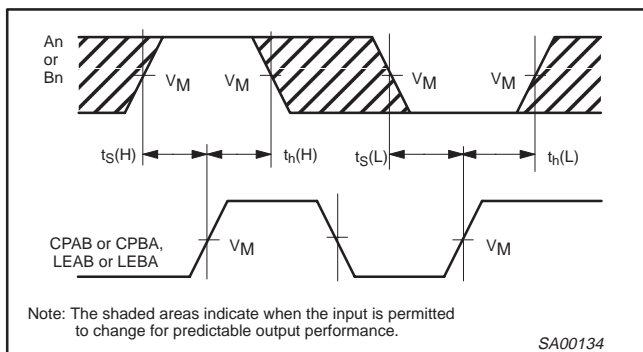
$V_M = 1.5\text{ V}$, $V_{IN} = \text{GND to } 3.0\text{ V}$



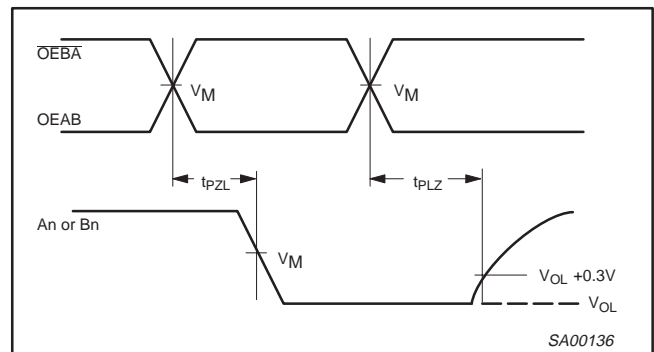
Waveform 3. Propagation Delay, Enable to Output, and Enable Pulse Width



Waveform 5. 3-State Output Enable Time to High Level and Output Disable Time from High Level



Waveform 4. Data Set-up and Hold Times



Waveform 6. 3-State Output Enable Time to Low Level and Output Disable Time from Low Level

TEST CIRCUIT AND WAVEFORMS

Test Circuit for 3-State Outputs

Input Pulse Definition

$V_M = 1.5\text{ V}$

SWITCH POSITION

TEST	SWITCH
t_{pLZ}	closed
t_{pZL}	closed
All other	open

DEFINITIONS

R_L = Load resistor; see AC CHARACTERISTICS for value.

C_L = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.

R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

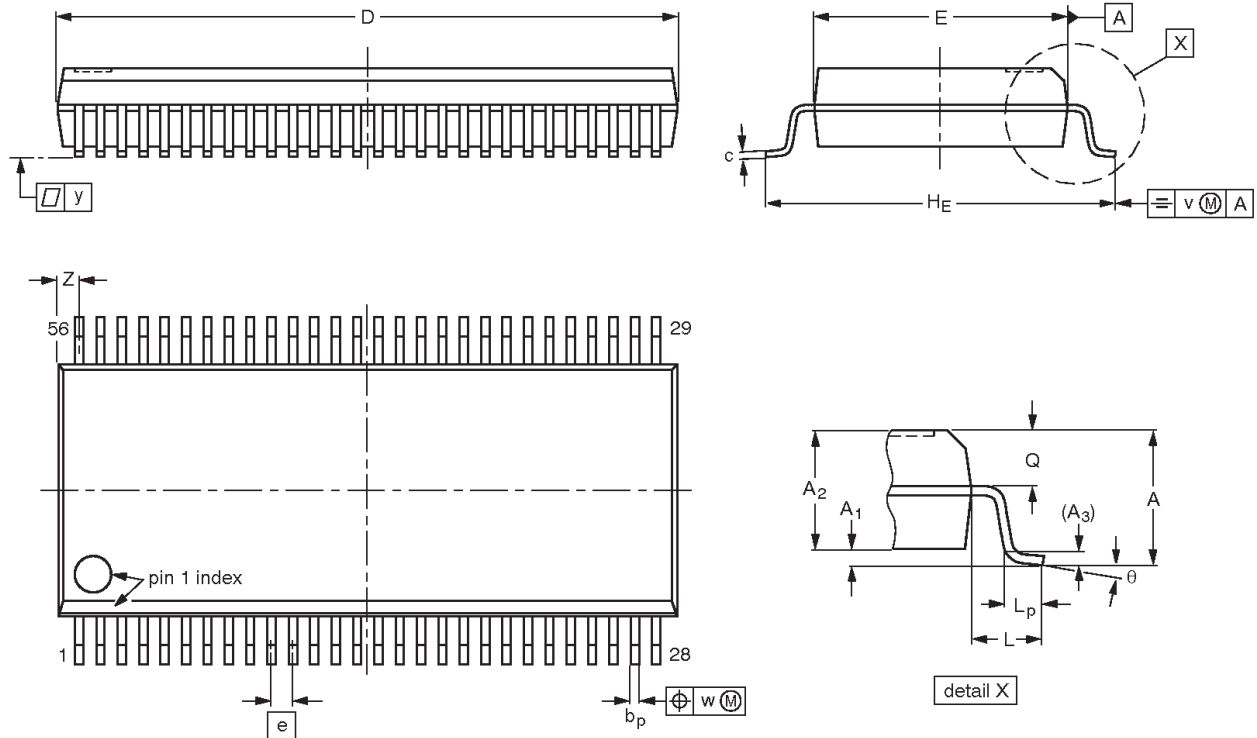
FAMILY	INPUT PULSE REQUIREMENTS				
	Amplitude	Rep. Rate	t_w	t_R	t_F
74ABT/H16	3.0V	1MHz	500ns	2.5ns	2.5ns

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SSOP56: plastic shrink small outline package; 56 leads; body width 7.5 mm

SOT371-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	2.8	0.4 0.2	2.35 2.20	0.25	0.3 0.2	0.22 0.13	18.55 18.30	7.6 7.4	0.635	10.4 10.1	1.4	1.0 0.6	1.2 1.0	0.25	0.18	0.1	0.85 0.40	8° 0°

Note

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

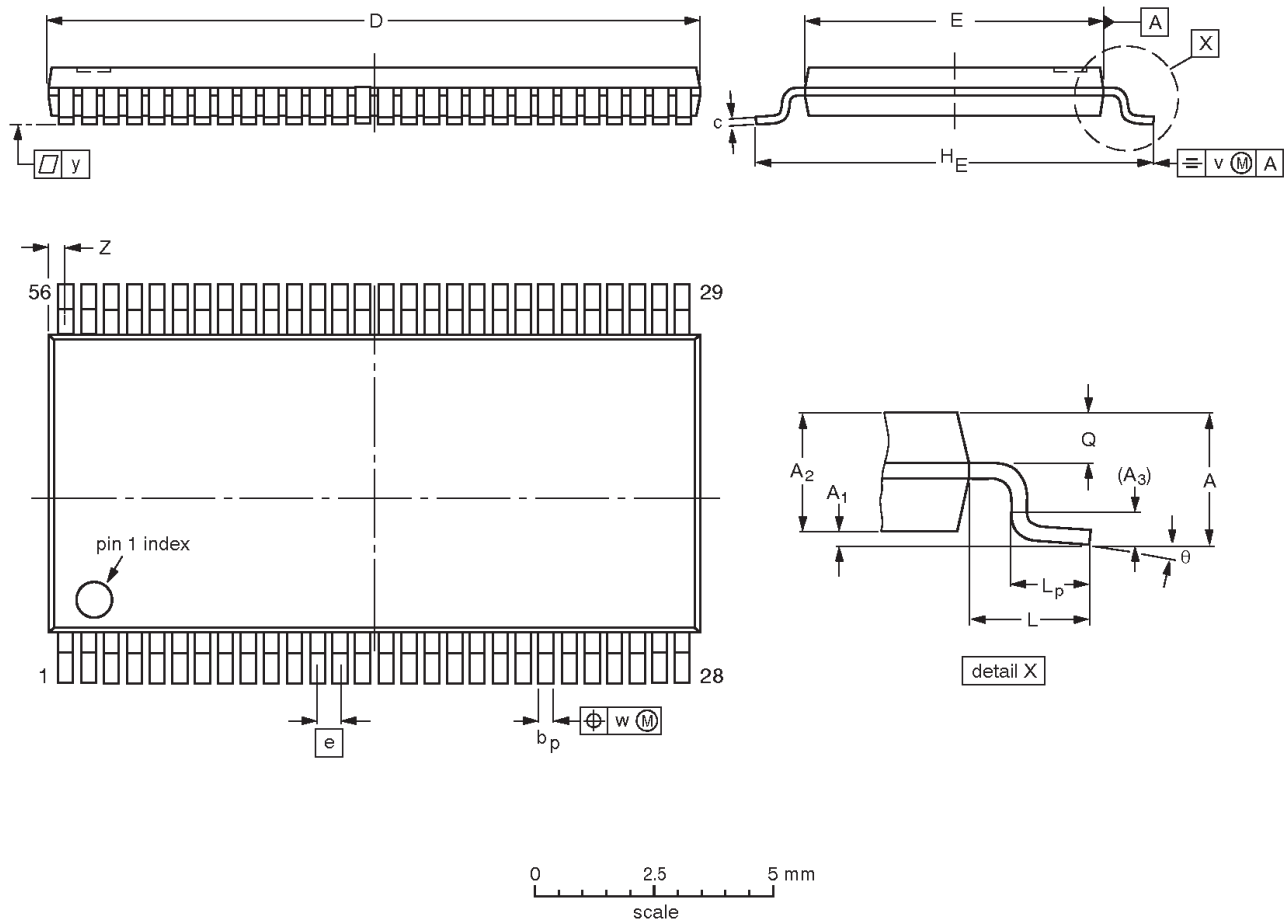
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT371-1		MO-118				95-02-04 99-12-27

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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	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-153				95-02-10 99-12-27

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Data sheet status

Data sheet status ^[1]	Product status ^[2]	Definitions
Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
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[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

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