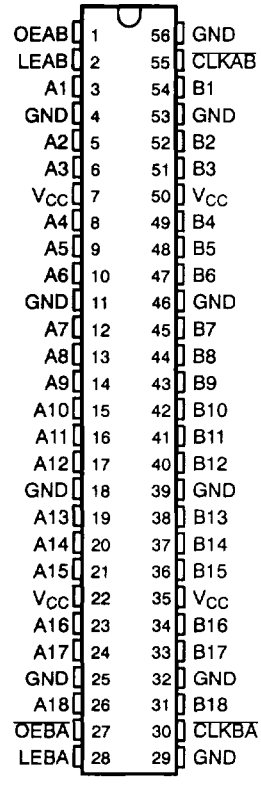
- **Members of the Texas Instruments *Widebus*™ Family**
- **State-of-the-Art *EPIC-IIB*™ BICMOS Design Significantly Reduces Power Dissipation**
- ***UBT*™ (Universal Bus Transceiver) Combines D-Type Latches and D-Type Flip-Flops for Operation in Transparent, Latched, or Clocked Mode**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)**
- **Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17**
- **Typical V_{OLP} (Output Ground Bounce) < 0.8 V at V_{CC} = 5 V, T_A = 25°C**
- **Flow-Through Architecture Optimizes PCB Layout**
- **Packaged in Plastic 300-mil Shrink Small-Outline Packages (DL) and 380-mil Fine-Pitch Ceramic Flat Packages (WD) Using 25-mil Center-to-Center Spacings**

SN54ABT16500A . . . WD PACKAGE
SN74ABT16500A . . . DL PACKAGE
(TOP VIEW)



description

These 18-bit universal bus transceivers combine D-type latches and D-type flip-flops to allow data flow in transparent, latched, and clocked modes.

Data flow in each direction is controlled by output-enable (OEAB and $\overline{\text{OEBA}}$), latch-enable (LEAB and LEBA), and clock ($\overline{\text{CLKAB}}$ and $\overline{\text{CLKBA}}$) 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 $\overline{\text{CLKAB}}$ 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 high-to-low transition of $\overline{\text{CLKAB}}$. Output-enable OEAB is active-high. 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 $\overline{\text{CLKBA}}$. The output enables are complementary (OEAB is active high and $\overline{\text{OEBA}}$ is active low).

To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

The SN74ABT16500A is packaged in TI's shrink small-outline package (DL), which provides twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

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description (continued)

The SN54ABT16500A is characterized over the full military temperature range of −55°C to 125°C. The SN74ABT16500A is characterized for operation from −40°C to 85°C.

FUNCTION TABLE†

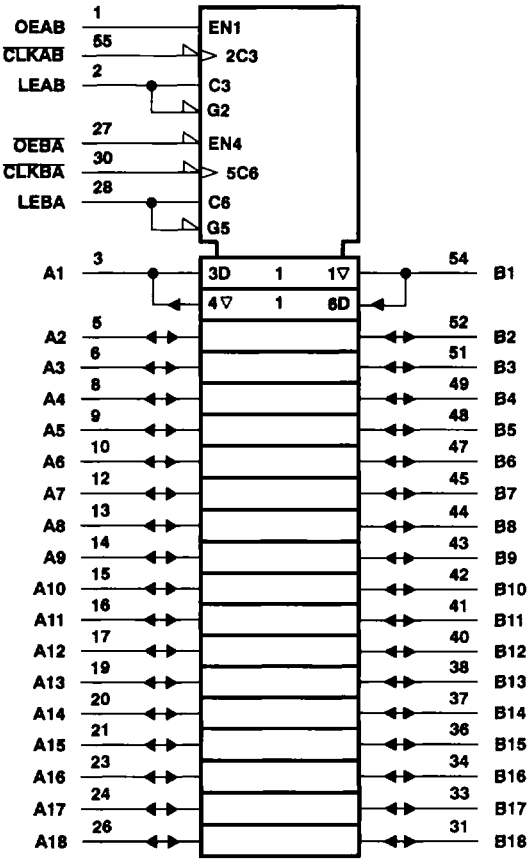
INPUTS				OUTPUT
OEAB	LEAB	$\overline{\text{CLKAB}}$	A	B
L	X	X	X	Z
H	H	X	L	L
H	H	X	H	H
H	L	↓	L	L
H	L	↓	H	H
H	L	H	X	B_0‡
H	L	L	X	B_0§

† A-to-B data flow is shown: B-to-A flow is similar but uses $\overline{\text{OEBA}}$, LEBA, and $\overline{\text{CLKBA}}$.

‡ Output level before the indicated steady-state input conditions were established.

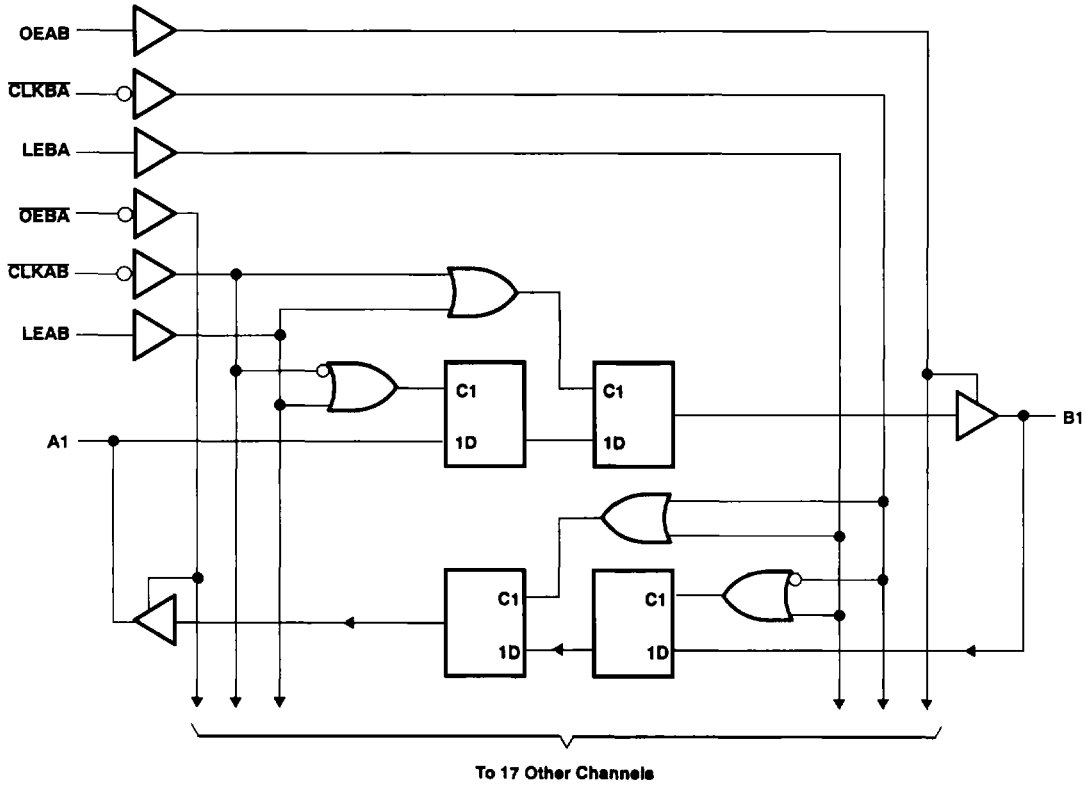
§ Output level before the indicated steady-state input conditions were established, provided that $\overline{\text{CLKAB}}$ was low before LEAB went low.

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC} ..... −0.5 V to 7 V
Input voltage range, V_I (except I/O ports) (see Note 1) ..... −0.5 V to 7 V
Voltage range applied to any output in the high state or power-off state, V_O ..... −0.5 V to 5.5 V
Current into any output in the low state, I_O: SN54ABT16500A ..... 96 mA
SN74ABT16500A ..... 128 mA
Input clamp current, I_{IK} (V_I < 0) ..... −18 mA
Output clamp current, I_{OK} (V_O < 0) ..... −50 mA
Maximum power dissipation at T_A = 55°C (in still air) ..... 1 W
Storage temperature range ..... −65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" 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.

NOTE 1: The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

recommended operating conditions (see Note 2)

			SN54ABT16500A		SN74ABT16500A		UNIT
			MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		4.5	5.5	4.5	5.5	V
V_{IH}	High-level input voltage		2		2		V
V_{IL}	Low-level input voltage			0.8		0.8	V
V_I	Input voltage		0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current			−24		−32	mA
I_{OL}	Low-level output current			48		64	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled		10		10	ns/V
T_A	Operating free-air temperature		−55	125	−40	85	°C

NOTE 2: Unused or floating pins (input or I/O) must be held high or low.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS			T_A = 25°C			SN54ABT16500A		SN74ABT16500A		UNIT
				MIN	TYP†	MAX	MIN	MAX	MIN	MAX	
V_{IK}	V_{CC} = 4.5 V,	I_I = −18 mA				−1.2		−1.2		−1.2	V
V_{OH}	V_{CC} = 4.5 V,	I_{OH} = −3 mA		2.5			2.5		2.5		V
	V_{CC} = 5 V,	I_{OH} = −3 mA		3			3		3		
	V_{CC} = 4.5 V,	I_{OH} = −24 mA		2			2				
	V_{CC} = 4.5 V,	I_{OH} = −32 mA		2‡					2		
V_{OL}	V_{CC} = 4.5 V,	I_{OL} = 48 mA				0.55		0.55			V
	V_{CC} = 4.5 V,	I_{OL} = 64 mA				0.55‡				0.55	
I_I	V_{CC} = 5.5 V,		Control inputs			±1		±1		±1	µA
	V_I = V_{CC} or GND		A or B ports			±100		±100		±100	
I_{OZH}§	V_{CC} = 5.5 V,	V_O = 2.7 V				50		50		50	µA
I_{OZL}§	V_{CC} = 5.5 V,	V_O = 0.5 V				−50		−50		−50	µA
I_{OFF}	V_{CC} = 0 V,	V_I or V_O ≤ 4.5 V				±100				±100	µA
I_{CEX}	V_{CC} = 5.5 V, V_O = 5.5 V		Outputs high			50		50		50	µA
I_O¶	V_{CC} = 5.5 V,	V_O = 2.5 V		−50	−100	−180	−50	−180	−50	−180	mA
I_{CC}	V_{CC} = 5.5 V,	A or B ports	Outputs high			3		3		3	mA
	I_O = 0,		Outputs low			76		76		76	
	V_I = V_{CC} or GND		Outputs disabled			3.3		3.3		3.3	
ΔI_{CC}#	V_{CC} = 5.5 V, One input at 3.4 V, Other inputs at V_{CC} or GND					1.5		1.5		1.5	mA
C_i	V_I = 2.5 V or 0.5 V		Control inputs		4						pF
C_{io}	V_O = 2.5 V or 0.5 V		A or B ports		8						pF

† All typical values are at V_{CC} = 5 V.
‡ On products compliant to MIL-STD-883, Class B, this parameter does not apply.
§ The parameters I_{OZH} and I_{OZL} include the input leakage current.
¶ 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 that is at the specified TTL voltage level rather than V_{CC} or GND.

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

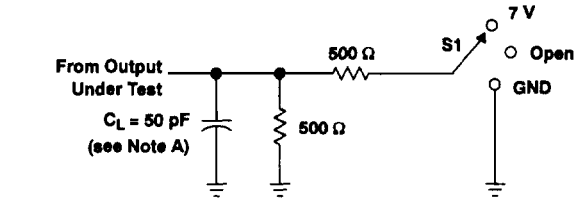
				SN54ABT16500A		SN74ABT16500A		UNIT
				MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency			0	150	0	150	MHz
t_w†	Pulse duration	LEAB or LEBA high		3.3		3.3		ns
		$\overline{CLKAB}$ or $\overline{CLKBA}$ high or low		3.3		3.3		
t_{su}	Setup time	A before $\overline{CLKAB}$↓		4.5		4.5		ns
		B before $\overline{CLKBA}$↓		4		4		
		A before LEAB↓ or B before LEBA↓	$\overline{CLK}$ high	1.5		1.5		
			$\overline{CLK}$ low	4.5		4.5		
t_h	Hold time	A after $\overline{CLKAB}$↓ or B after $\overline{CLKBA}$↓		0		0		ns
		A after LEAB↓ or B after LEBA↓		1.5		1.5		

† This parameter is specified by design but not tested.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C_L = 50 pF (unless otherwise noted) (see Figure 1)

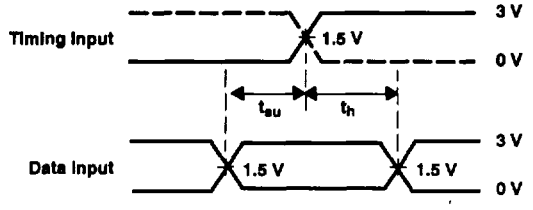
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 5 V, T_A = 25°C			SN54ABT16500A		SN74ABT16500A		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			150	200		150		150		MHz
t_{PLH}	A or B	B or A	1.1	2.7	3.6	1.1	4.4	1.1	4	ns
t_{PHL}			1	2.9	3.9	1	4.6	1	4.6	
t_{PLH}	LEAB or LEBA	B or A	1	3.4	4.7	1	5.6	1	5.3	ns
t_{PHL}			1	3.4	4.7	1	5.4	1	5	
t_{PLH}	$\overline{CLKAB}$ or $\overline{CLKBA}$	B or A	1	3.1	4.4	1	5.4	1	5.3	ns
t_{PHL}			1	3.1	4.3	1	5.2	1	5	
t_{PZH}	OEAB or $\overline{OEBA}$	B or A	1	2.9	4.1	1	4.8	1	4.8	ns
t_{PZL}			2.5	4.5	5.7	2.5	6.9	2.5	6.6	
t_{PHZ}	OEAB or $\overline{OEBA}$	B or A	1.5	4.5	5.2	1.5	6.6	1.5	6.2	ns
t_{PLZ}			1.4	3.4	4.7	1.4	5.8	1.4	5.4	

PARAMETER MEASUREMENT INFORMATION

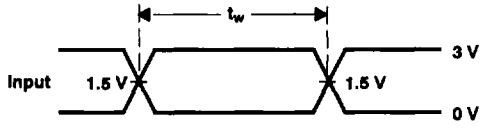


LOAD CIRCUIT FOR OUTPUTS

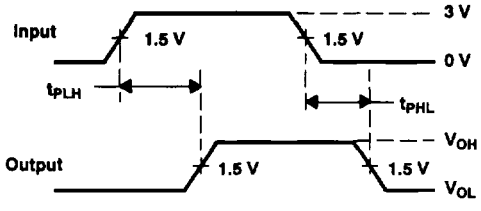
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open



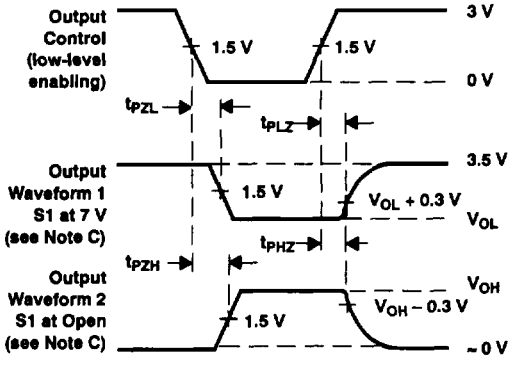
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

NOTES: A. C_L includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
C. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms