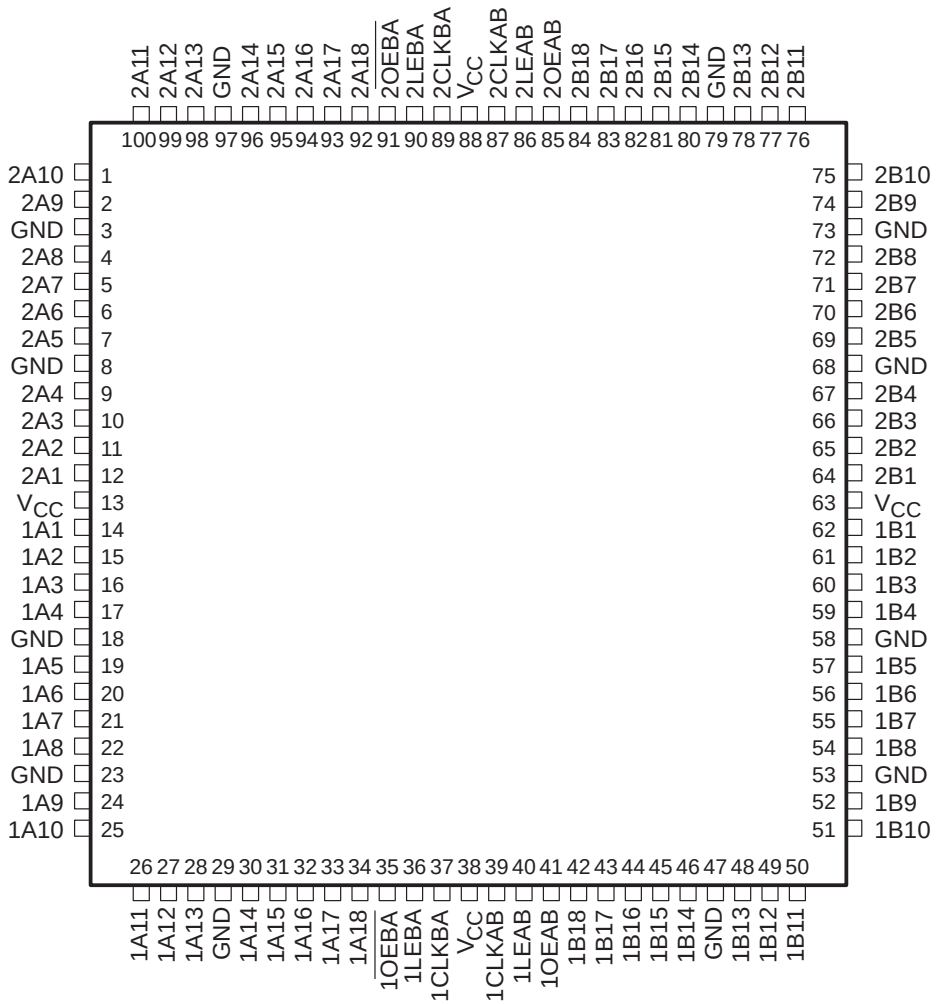
- **Members of the Texas Instruments *Widebus*+™ Family**
- **State-of-the-Art *EPIC*-IIB™ BiCMOS Design Significantly Reduces Power Dissipation**
- ***UBT*™ (Universal Bus Transceiver) Combines D-Type Latches and D-Type Flip-Flops for Operation in Transparent, Latched, or Clocked Mode**
- **ESD Protection 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**
- **Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise**
- **High-Drive Outputs (−32-mA I_{OH}, 64-mA I_{OL})**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**
- **Packaged in 100-Pin Plastic Thin Quad Flat (PZ) Package With 14 × 14-mm Body Using 0.5-mm Lead Pitch**

′ABT32501 . . . PZ PACKAGE
(TOP VIEW)



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description

These 36-bit UBTs 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 (CLKAB and 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 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 low-to-high transition of CLKAB. Data flow for B to A is similar to that of A to B, but uses $\overline{\text{OEBA}}$, LEBA, and CLKBA.

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. 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, $\overline{\text{OEBA}}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver (B to A). OEAB 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 (A to B).

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

The SN54ABT32501 is characterized for operation over the full military temperature range of −55°C to 125°C. The SN74ABT32501 is characterized for operation from −40°C to 85°C.

FUNCTION TABLE†

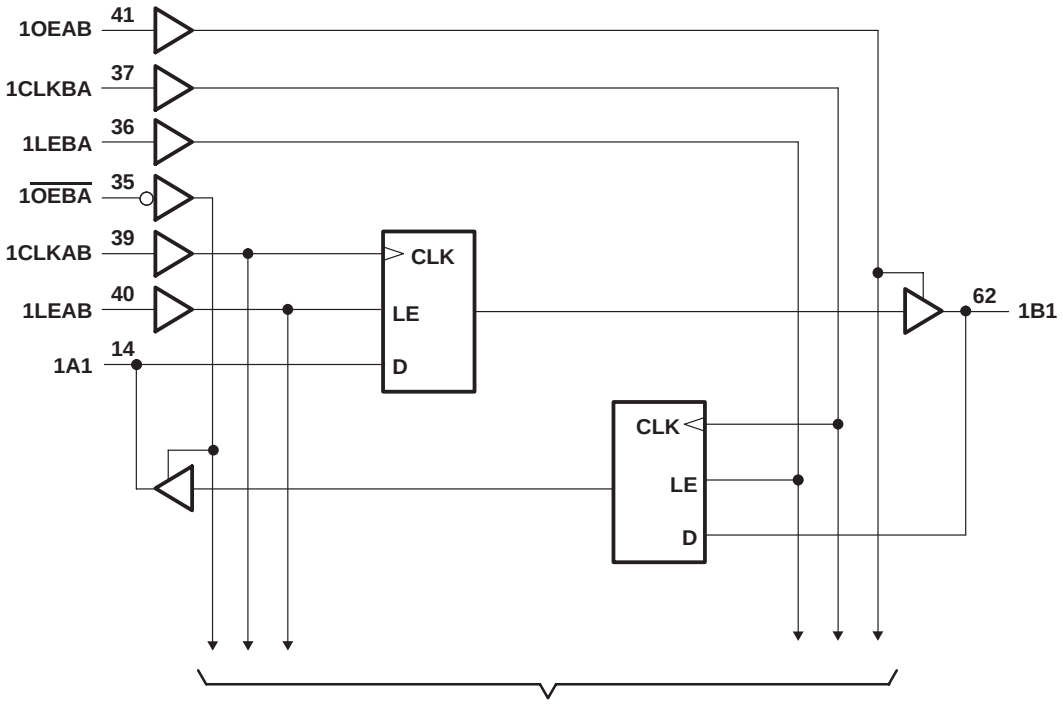
INPUTS				OUTPUT
OEAB	LEAB	CLKAB	A	B
L	X	X	X	Z
H	H	X	L	L
H	H	X	H	H
H	L	↑	L	L
H	L	↑	H	H
H	L	H	X	B_0‡
H	L	L	X	B_0§

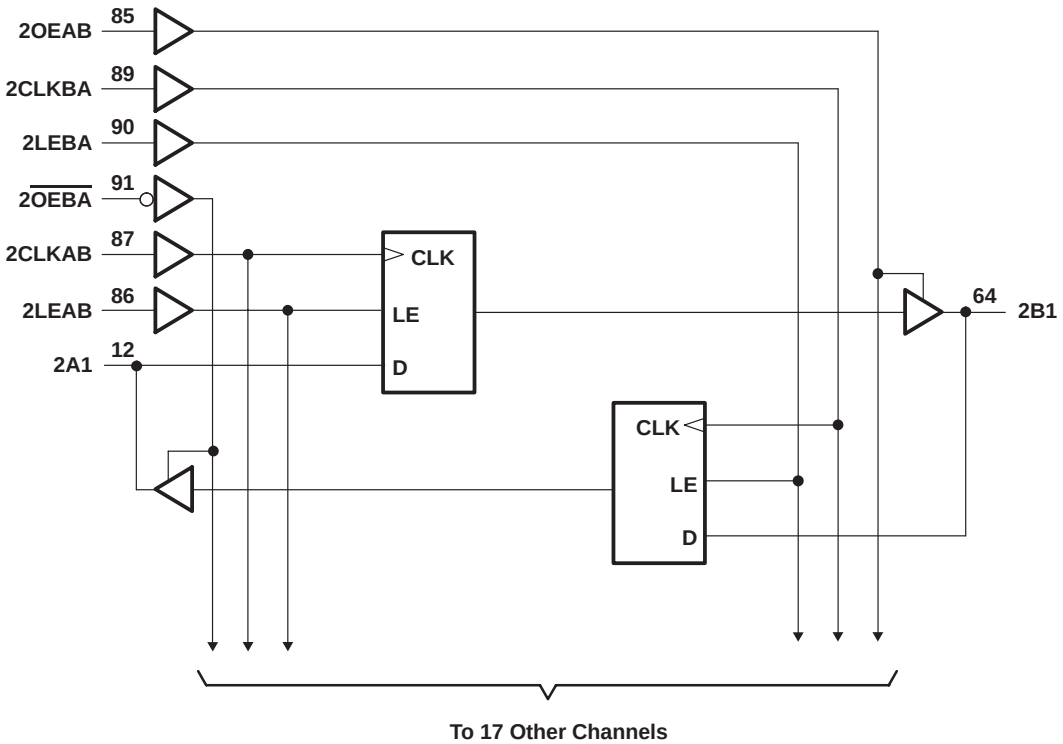
† A-to-B data flow is shown: B-to-A flow is similar, but uses $\overline{\text{OEBA}}$, LEBA, and CLKBA.

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

§ Output level before the indicated steady-state input conditions were established, provided that CLKAB was low before LEAB went low

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: SN54ABT32501 . . . . . 96 mA
SN74ABT32501 . . . . . 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) (see Note 2) . . . . . 1.2 W
Operating free-air temperature range, T_A: SN54ABT32501 . . . . . −55°C to 125°C
SN74ABT32501 . . . . . −40°C to 85°C
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.

NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 75 mils. For more information, refer to the *Package Thermal Considerations* application note in the 1994 *ABT Advanced BiCMOS Technology Data Book*, literature number SCBD002B.

recommended operating conditions (see Note 3)

			SN54ABT32501		SN74ABT32501		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
$\Delta t/\Delta V_{CC}$	Power-up ramp rate		200		200		µs/V
T_A	Operating free-air temperature		−55	125	−40	85	°C

NOTE 3: 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			SN54ABT32501			SN74ABT32501			UNIT
					MIN	TYP†	MAX	MIN	TYP†	MAX	
V_{IK}		V_{CC} = 4.5 V,	I_I = −18 mA				−1.2			−1.2	V
V_{OH}		V_{CC} = 4.5 V,	I_{OH} = −3 mA		2.5			2.5			V
		V_{CC} = 5 V,	I_{OH} = −3 mA		3			3			
		V_{CC} = 4.5 V	I_{OH} = −24 mA		2						
			I_{OH} = −32 mA					2			
V_{OL}		V_{CC} = 4.5 V	I_{OL} = 48 mA				0.55			0.55	V
			I_{OL} = 64 mA							0.55	
I_I	Control inputs	V_{CC} = 0 to 5.5 V,	V_I = V_{CC} or GND				±1			±1	µA
	A or B ports	V_{CC} = 2.1 V to 5.5 V,	V_I = V_{CC} or GND				±20			±20	
$I_{I(hold)}$	A or B ports	V_{CC} = 4.5 V	V_I = 0.8 V		100			100			µA
			V_I = 2 V		−100			−100			
I_{OZPU}‡		V_{CC} = 0 to 2.1 V	V_O = 0.5 V to 2.7 V, OE or $\overline{OE}$ = X				±50			±50	µA
I_{OZPD}‡		V_{CC} = 2.1 V to 0					±50			±50	µA
I_{OZH}§		V_{CC} = 2.1 V to 5.5 V, $\overline{OE}$ ≥ 2 V,	V_O = 2.7 V, OE ≤ 0.8 V¶				10			10	µA
I_{OZL}§		V_{CC} = 2.1 V to 5.5 V, $\overline{OE}$ ≥ 2 V,	V_O = 0.5 V, OE ≤ 0.8 V¶				−10			−10	µA
I_{off}		V_{CC} = 0,	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	µA
I_O#		V_{CC} = 5.5 V,	V_O = 2.5 V		−50	−100	−180	−50	−100	−180	mA
I_{CC}		V_{CC} = 5.5 V, I_O = 0, V_I = V_{CC} or GND	Outputs high				6			6	mA
			Outputs low				90			90	
			Outputs disabled				6			6	
ΔI_{CC}‖		V_{CC} = 5.5 V, Other inputs at V_{CC} or GND	One input at 3.4 V,				1			1	mA
C_i	Control inputs	V_I = 2.5 V or 0.5 V				3.5			3.5		pF
C_{io}	A or B ports	V_O = 2.5 V or 0.5 V				11.5			11.5		pF

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ This parameter is specified by characterization.
§ The parameters I_{OZH} and I_{OZL} include the input leakage current.
¶ For V_{CC} between 2.1 V and 4 V, OE should be less than or equal to 0.5 V to ensure a low state.
# 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) (see Figure 1)

			SN54ABT32501		SN74ABT32501		UNIT
			MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		0	150	0	150	MHz
t_w	Pulse duration	LE high	3.3		3.3		ns
		CLK high or low	3.3		3.3		
t_{su}	Setup time	A or B before CLK↑	3.5		3.5		ns
		A or B before LE↓	1.6		1.6		
t_h	Hold time	A or B after CLK↑	0		0		ns
		A or B after LE↓	1.6		1.6		

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)	SN54ABT32501			SN74ABT32501			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
f_{max}			150			150			MHz
t_{PLH}	A or B	B or A	1.3	2.9	4.8	1.3	2.9	4.8	ns
t_{PHL}			1.4	2.7	5.4	1.4	2.7	5.4	
t_{PLH}	LEAB or LEBA	B or A	1.6	3.4	5.3	1.6	3.4	5.3	ns
t_{PHL}			1.9	3.6	5.5	1.9	3.6	5.5	
t_{PLH}	CLKAB or CLKBA	B or A	1.5	3.2	5.3	1.5	3.2	5.3	ns
t_{PHL}			1.7	3.3	5.4	1.7	3.3	5.4	
t_{PZH}	OEAB or $\overline{OEBA}$	B or A	1.2	3.2	5.6	1.2	3.2	5.6	ns
t_{PZL}			1.5	3.6	6	1.5	3.6	6	
t_{PHZ}	OEAB or $\overline{OEBA}$	B or A	1.8	3.6	5.9	1.8	3.6	5.9	ns
t_{PLZ}			1.7	3.5	5.6	1.7	3.5	5.6	

† All typical values are at V_{CC} = 5 V, T_A = 25°C.

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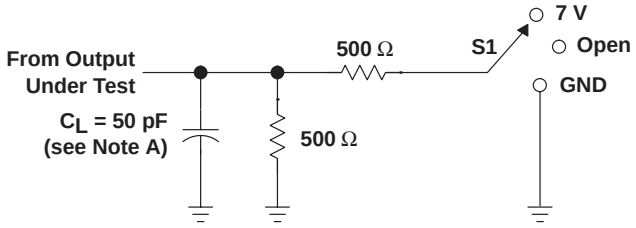
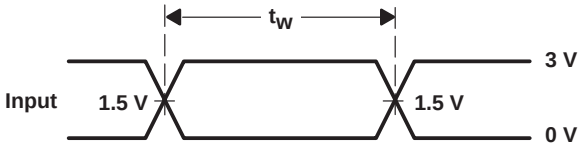
PARAMETER MEASUREMENT INFORMATION

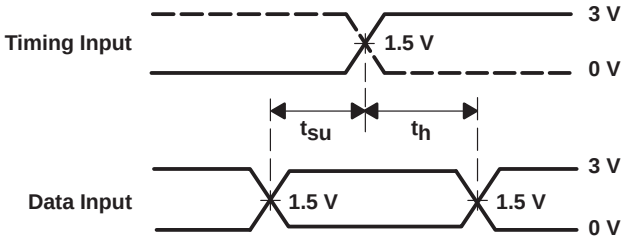


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open

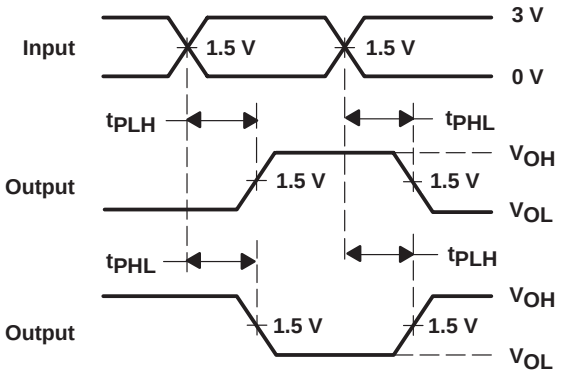
LOAD CIRCUIT FOR OUTPUTS



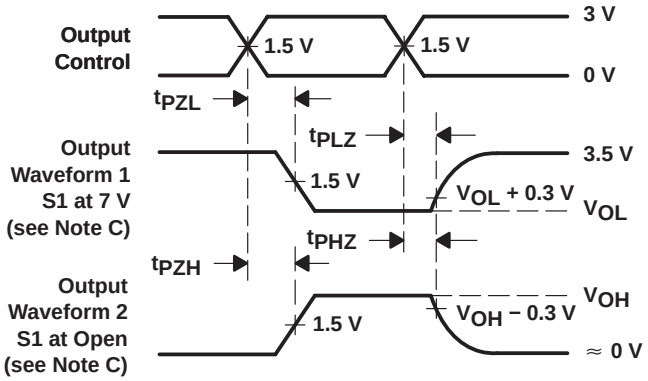
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

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

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