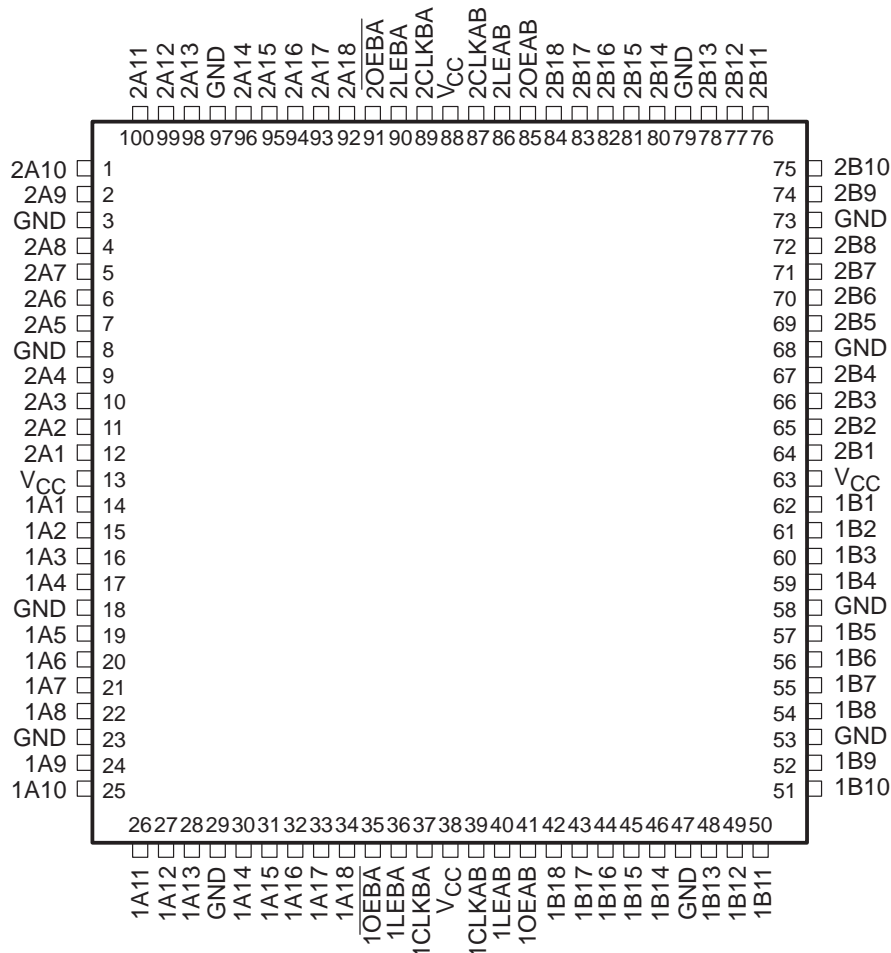


# SN54ABTH32501, SN74ABTH32501 36-BIT UNIVERSAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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- Members of the Texas Instruments *Widebus+*™ Family
- State-of-the-Art *EPIC-II B*™ 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-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17
- Released as DSCC SMD 5962-9557601NXD
- Typical  $V_{OLP}$  (Output Ground Bounce) < 0.8 V at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$
- High-Impedance State During Power Up and Power Down
- 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
- Package Options Include 100-Pin Plastic Thin Quad Flat (PZ) Package With 14 × 14-mm Body Using 0.5-mm Lead Pitch and Space-Saving 100-Pin Ceramic Quad Flat (HS) Package†

†ABTH32501 . . . PZ PACKAGE  
(TOP VIEW)



† The HS package is not production released.



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



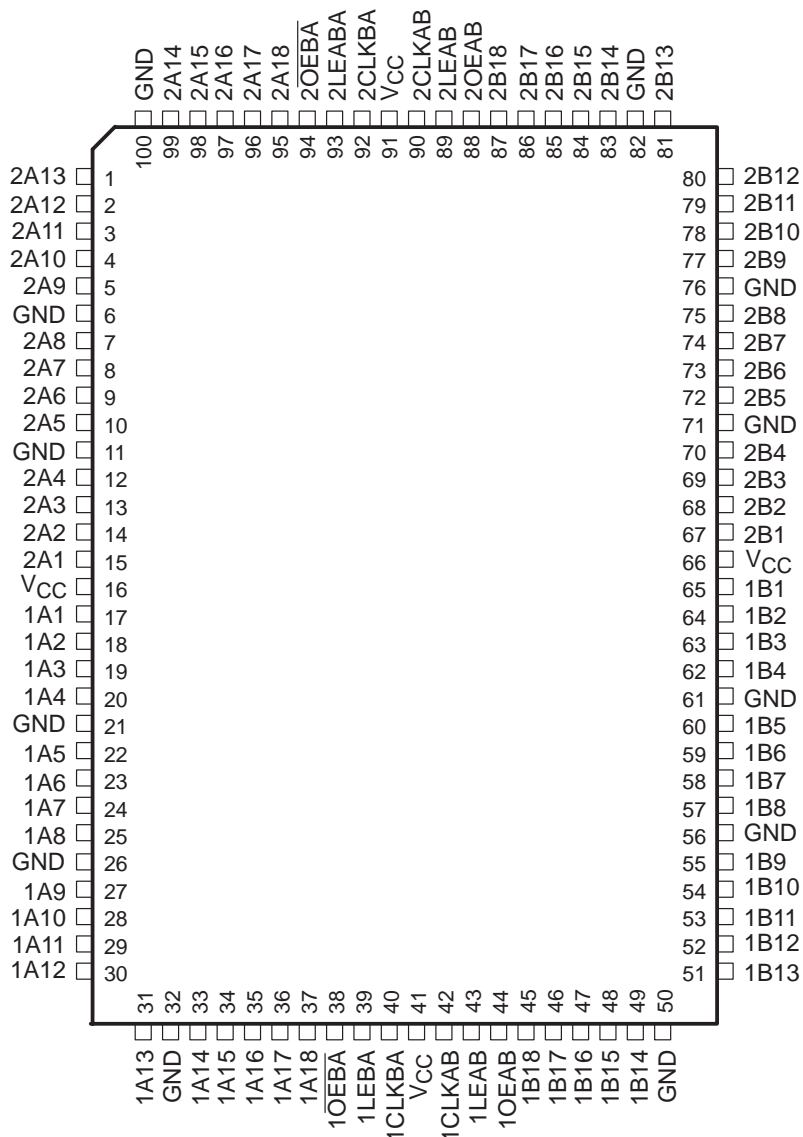
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# SN54ABTH32501, SN74ABTH32501 36-BIT UNIVERSAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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## SN54ABTH32501 . . . HS PACKAGE† (TOP VIEW)



† For HS package availability, please contact the factory or your local TI Field Sales Office.



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# SN54ABTH32501, SN74ABTH32501 36-BIT UNIVERSAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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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 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).

When  $V_{CC}$  is between 0 and 2.1 V, the device is in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 2.1 V,  $\overline{\text{OE}}$  should be tied to  $V_{CC}$  through a pullup resistor and OE should be tied to GND through a pulldown 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.

The SN54ABTH32501 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ABTH32501 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

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	$B_0^{\ddagger}$
H	L	L	X	$B_0^{\S}$

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

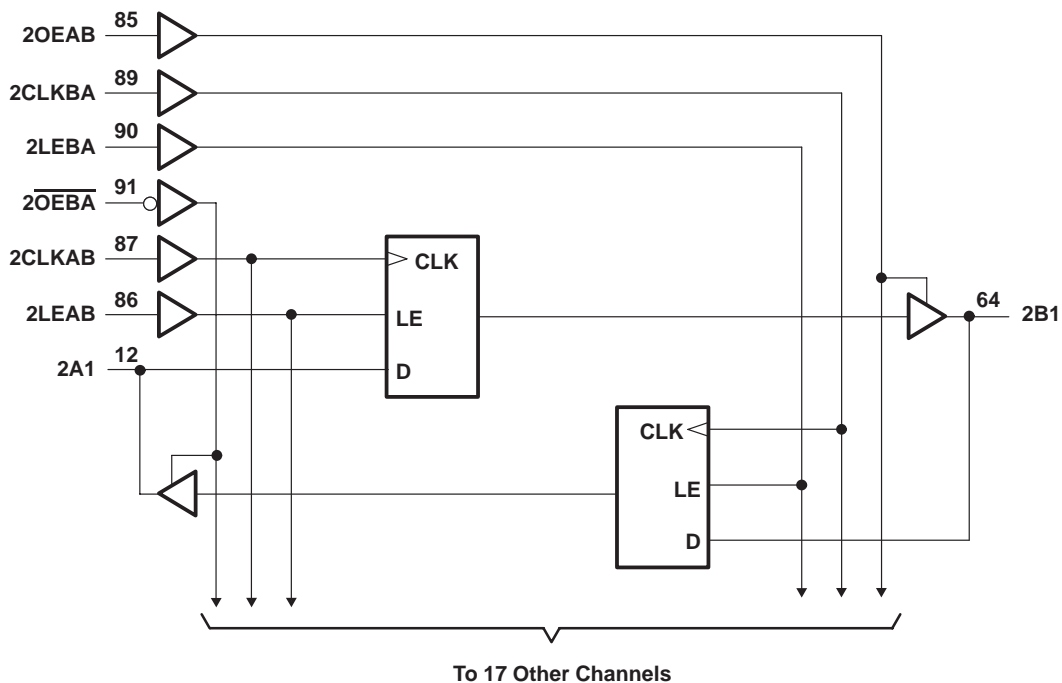
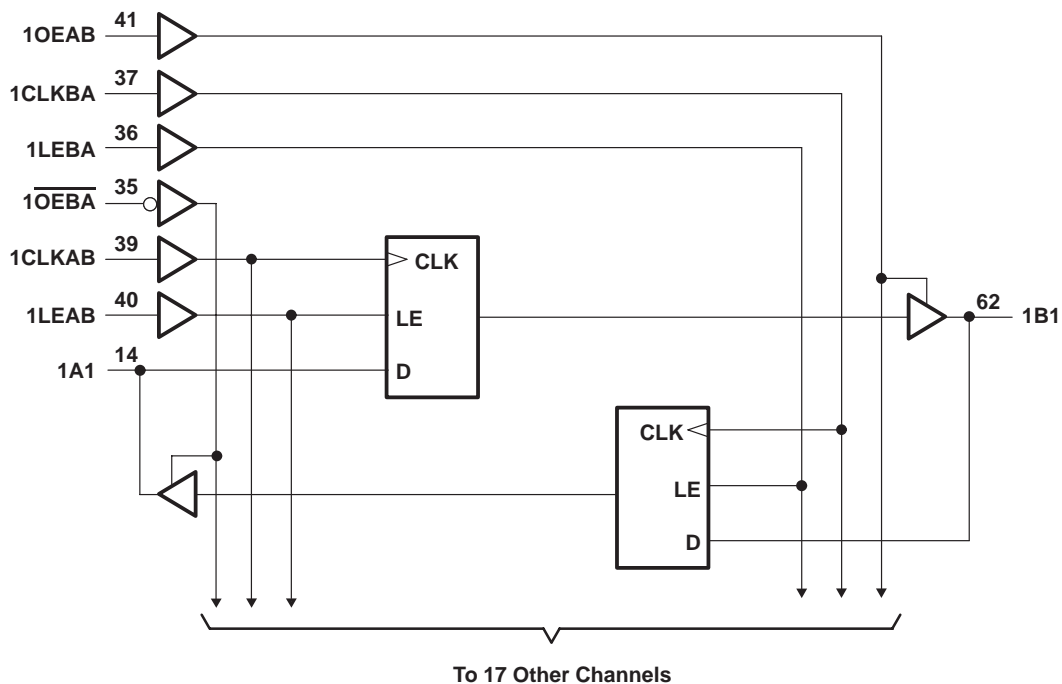
‡ Output level before the indicated steady-state input conditions were established

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

# SN54ABTH32501, SN74ABTH32501 36-BIT UNIVERSAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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## logic diagram (positive logic)



Pin numbers shown are for the PZ package.



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# SN54ABTH32501, SN74ABTH32501 36-BIT UNIVERSAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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## 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 or power-off state, $V_O$ .....	–0.5 V to 5.5 V
Current into any output in the low state, $I_O$ : SN54ABTH32501 .....	96 mA
SN74ABTH32501 .....	128 mA
Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....	–18 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ ) .....	–50 mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): PZ package .....	50°C/W
Storage temperature range, $T_{stg}$ .....	–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 package thermal impedance is calculated in accordance with EIA/JEDEC Std JESD51.

## recommended operating conditions (see Note 3)

		SN54ABTH32501		SN74ABTH32501		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 control pins must be held high or low to prevent them from floating.



# SN54ABTH32501, SN74ABTH32501

## 36-BIT UNIVERSAL BUS TRANSCEIVERS

### WITH 3-STATE OUTPUTS

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

PARAMETER		TEST CONDITIONS	SN54ABTH32501			SN74ABTH32501			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
V <sub>IK</sub>		V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA	-1.2			-1.2			V
V <sub>OH</sub>		V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -3 mA	2.5			2.5			V
		V <sub>CC</sub> = 5 V, I <sub>OH</sub> = -3 mA	3			3			
		V <sub>CC</sub> = 4.5 V	2			2			
V <sub>OL</sub>		V <sub>CC</sub> = 4.5 V	I <sub>OL</sub> = 48 mA			0.55			V
			I <sub>OL</sub> = 64 mA			0.55			
V <sub>hys</sub>			100			100			mV
I <sub>I</sub>	Control inputs	V <sub>CC</sub> = 0 to 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND				±1			μA
	A or B ports	V <sub>CC</sub> = 2.1 V to 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND				±20			
	Control inputs	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND	±5						
	A or B ports		±50						
I <sub>I(hold)</sub>	A or B ports	V <sub>CC</sub> = 4.5 V	V <sub>I</sub> = 0.8 V			100			μA
			V <sub>I</sub> = 2 V			-100			
I <sub>OZPU</sub> ‡		V <sub>CC</sub> = 0 to 2.1 V, V <sub>O</sub> = 0.5 V to 2.7 V, OE or $\overline{OE}$ = X	±50			±50			μA
I <sub>OZPD</sub> ‡		V <sub>CC</sub> = 2.1 V to 0, V <sub>O</sub> = 0.5 V to 2.7 V, OE or $\overline{OE}$ = X	±50			±50			μA
I <sub>off</sub>		V <sub>CC</sub> = 0, V <sub>I</sub> or V <sub>O</sub> ≤ 4.5 V				±100			μA
I <sub>CEX</sub>		V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 5.5 V	Outputs high			50			μA
I <sub>O</sub> §		V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.5 V	-50	-100	-180	-50	-100	-180	mA
I <sub>CC</sub>		V <sub>CC</sub> = 5.5 V, I <sub>O</sub> = 0, V <sub>I</sub> = V <sub>CC</sub> or GND	Outputs high			6			mA
			Outputs low			90			
			Outputs disabled			6			
ΔI <sub>CC</sub> ¶		V <sub>CC</sub> = 5.5 V, One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND	1			1			mA
C <sub>i</sub>	Control inputs	V <sub>I</sub> = 2.5 V or 0.5 V	3.5			3.5			pF
C <sub>io</sub>	A or B ports	V <sub>O</sub> = 2.5 V or 0.5 V	11.5			11.5			pF

† All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

‡ This parameter is specified by characterization.

§ 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<sub>CC</sub> or GND.

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1)

			SN54ABTH32501		SN74ABTH32501		UNIT
			MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency		0	150	0	150	MHz
t <sub>w</sub>	Pulse duration	LE high	3.5		3.3		ns
		CLK high or low	3.5		3.3		
t <sub>su</sub>	Setup time	A or B before CLK↑	4.3		3.5		ns
		A or B before LE↓	2.5		1.6		
t <sub>h</sub>	Hold time	A or B after CLK↑	0.2		0		ns
		A or B after LE↓	1.8		1.6		



**SN54ABTH32501, SN74ABTH32501**  
**36-BIT UNIVERSAL BUS TRANSCEIVERS**  
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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)	SN54ABTH32501			SN74ABTH32501			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
$f_{max}$			150			150			MHz
$t_{PLH}$	A or B	B or A	0.5	2.9	5.2	1.3	2.9	4.8	ns
$t_{PHL}$			0.5	2.7	5.8	1.4	2.7	5.4	
$t_{PLH}$	LEAB or LEBA	A or B	0.7	3.4	5.7	1.6	3.4	5.3	ns
$t_{PHL}$			0.7	3.6	5.9	1.9	3.6	5.5	
$t_{PLH}$	CLKAB or CLKBA	A or B	0.5	3.2	5.7	1.5	3.2	5.3	ns
$t_{PHL}$			0.7	3.3	5.8	1.7	3.3	5.4	
$t_{PZH}$	OEAB or $\overline{OEBA}$	A or B	0.5	3.2	6.2	1.2	3.2	5.6	ns
$t_{PZL}$			0.5	3.6	6.6	1.5	3.6	6	
$t_{PHZ}$	OEAB or $\overline{OEBA}$	A or B	0.7	3.6	7	1.8	3.6	5.9	ns
$t_{PLZ}$			0.7	3.5	6.1	1.7	3.5	5.6	

† All typical values are at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$ .

**SN54ABTH32501, SN74ABTH32501**  
**36-BIT UNIVERSAL BUS TRANSCEIVERS**  
**WITH 3-STATE OUTPUTS**

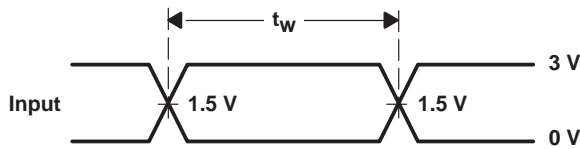
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**PARAMETER MEASUREMENT INFORMATION**

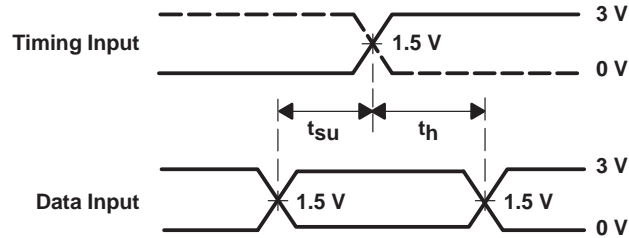


**LOAD CIRCUIT**

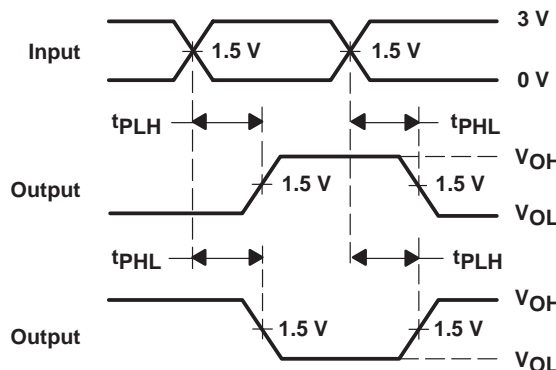
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	7 V
$t_{PHZ}/t_{PZH}$	Open



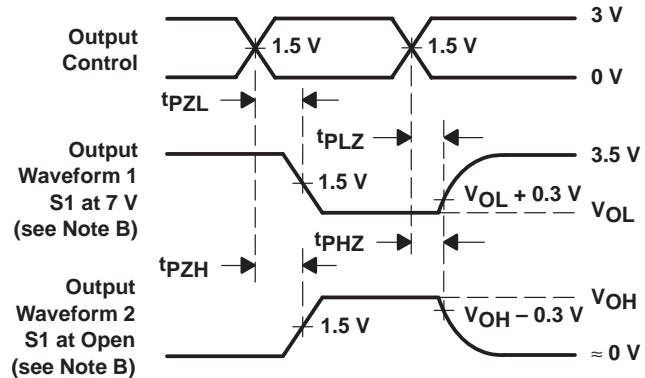
**VOLTAGE WAVEFORMS**  
**PULSE DURATION**



**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. 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.  
 C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .  
 D. The outputs are measured one at a time with one transition per measurement.

**Figure 1. Load Circuit and Voltage Waveforms**



**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
5962-9557601NXD	OBSOLETE	LQFP	PZ	100		TBD	Call TI	Call TI
SN74ABTH32501PZ	ACTIVE	LQFP	PZ	100	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
SN74ABTH32501PZG4	ACTIVE	LQFP	PZ	100	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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PZ (S-PQFP-G100)

PLASTIC QUAD FLATPACK



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Falls within JEDEC MS-026

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Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Low Power Wireless	<a href="http://www.ti.com/lpw">www.ti.com/lpw</a>	Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
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