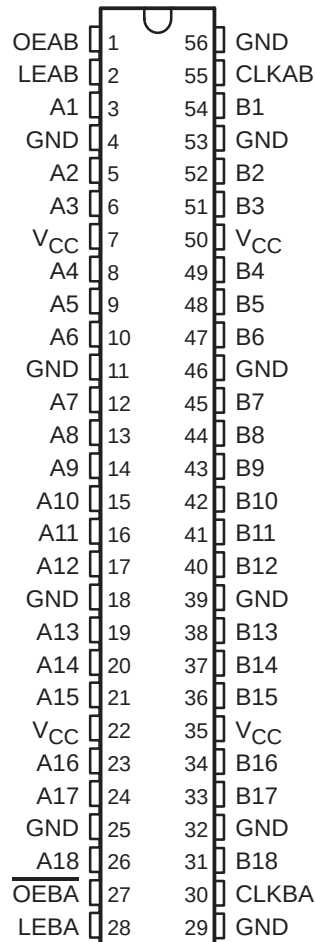


SN54ABT162501, SN74ABT162501 18-BIT UNIVERSAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS243E – SEPTEMBER 1992 – REVISED FEBRUARY 1999

- **Members of the Texas Instruments *Widebus*™ Family**
- **B-Port Outputs Have Equivalent 25-Ω Series Resistors, So No External Resistors Are Required**
- **State-of-the-Art *EPIC-II*™ 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**
- **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**
- **Flow-Through Architecture Optimizes PCB Layout**
- **Latch-Up Performance Exceeds 500 mA Per JESD 17**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model ($C = 200$ pF, $R = 0$)**
- **Package Options Include Plastic Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings**

SN54ABT162501 . . . WD PACKAGE
SN74ABT162501 . . . DGG OR DL PACKAGE
(TOP VIEW)



description

These 18-bit universal bus transceivers consist of storage elements that can operate either as D-type latches or D-type flip-flops to allow data flow in transparent or clocked modes.

Data flow in each direction is controlled by output-enable ($\overline{\text{OEAB}}$ 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 . 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 CLKBA . The output enables are complementary (OEAB is active high and $\overline{\text{OEBA}}$ is active low).

The B-port outputs, which are designed to source or sink up to 12 mA, include equivalent 25-Ω series resistors to reduce overshoot and undershoot.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

Widebus, EPIC-II, and UBT are trademarks of Texas Instruments Incorporated.

UNLESS OTHERWISE NOTED this document contains PRODUCTION DATA information 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.

**TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 1999, Texas Instruments Incorporated

SN54ABT162501, SN74ABT162501

18-BIT UNIVERSAL BUS TRANSCEIVERS

WITH 3-STATE OUTPUTS

SCBS243E – SEPTEMBER 1992 – REVISED FEBRUARY 1999

description (continued)

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, $\overline{OE}$ 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.

The SN54ABT162501 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74ABT162501 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	$B_0^{\ddagger}$
H	L	L	X	$B_0^{\S}$

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

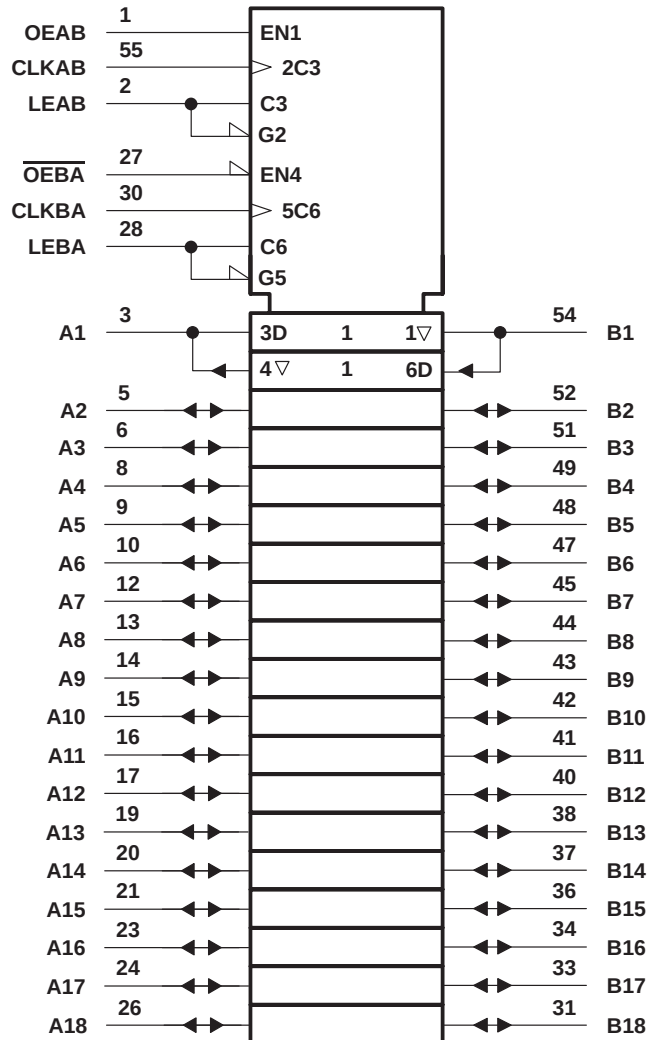
[‡] Output level before the indicated steady-state input conditions were established, provided that CLKAB was high before LEAB went low

[§] Output level before the indicated steady-state input conditions were established

SN54ABT162501, SN74ABT162501
18-BIT UNIVERSAL BUS TRANSCEIVERS
WITH 3-STATE OUTPUTS

SCBS243E – SEPTEMBER 1992 – REVISED FEBRUARY 1999

logic symbol[†]



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

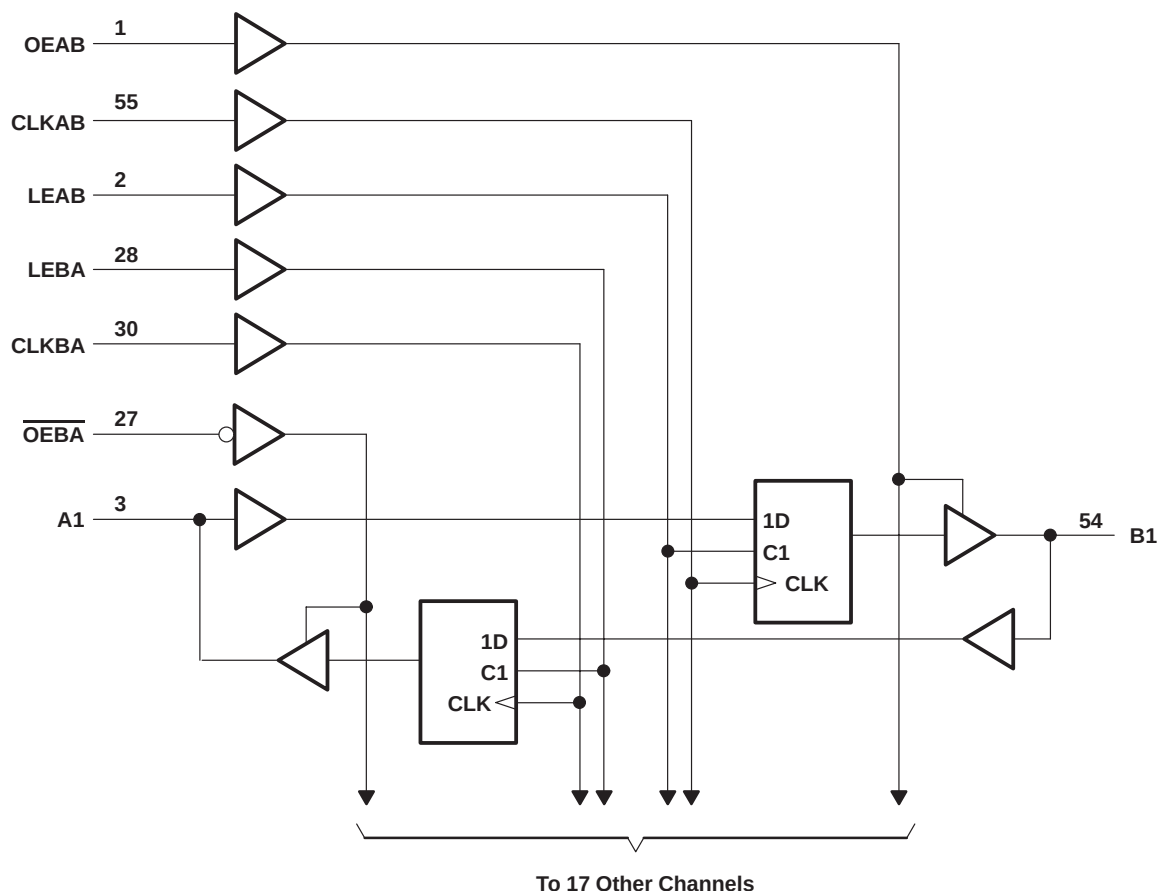
SN54ABT162501, SN74ABT162501

18-BIT UNIVERSAL BUS TRANSCEIVERS

WITH 3-STATE OUTPUTS

SCBS243E – SEPTEMBER 1992 – REVISED FEBRUARY 1999

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 or power-off state, V_O	–0.5 V to 5.5 V
Current into any output in the low state, I_O : SN54ABT162501 (A port)	96 mA
SN74ABT162501 (A port)	128 mA
B port	30 mA
Input clamp current, I_{IK} ($V_I < 0$)	–18 mA
Output clamp current, I_{OK} ($V_O < 0$)	–50 mA
Package thermal impedance, θ_{JA} (see Note 2): DGG package	81°C/W
DL package	74°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 JEDEC 51.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

SN54ABT162501, SN74ABT162501 18-BIT UNIVERSAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS243E – SEPTEMBER 1992 – REVISED FEBRUARY 1999

recommended operating conditions (see Note 3)

			SN54ABT162501		SN74ABT162501		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	A port		–24		–32	mA
		B port		–12		–12	
I_{OL}	Low-level output current	A port		48		64	mA
		B port		12		12	
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled		10		10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate		200		200		μ s/V
T_A	Operating free-air temperature		–55	125	–40	85	°C

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

SN54ABT162501, SN74ABT162501

18-BIT UNIVERSAL BUS TRANSCEIVERS

WITH 3-STATE OUTPUTS

SCBS243E – SEPTEMBER 1992 – REVISED FEBRUARY 1999

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

PARAMETER		TEST CONDITIONS		T _A = 25°C			SN54ABT162501		SN74ABT162501		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}	A port	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				
			I _{OH} = -32 mA		2*					2		
	B port	V _{CC} = 4.5 V, I _{OH} = -1 mA		3.35			3.3		3.35			
		V _{CC} = 5 V, I _{OH} = -1 mA		3.85			3.8		3.85			
		V _{CC} = 4.5 V	I _{OH} = -3 mA		3.1			3		3.1		
			I _{OH} = -12 mA		2.6					2.6		
V _{OL}	A port	V _{CC} = 4.5 V	I _{OL} = 48 mA		0.55			0.55		V		
			I _{OL} = 64 mA		0.55*			0.55				
	B port	V _{CC} = 4.5 V, I _{OL} = 12 mA		0.8			0.8		0.8			
V _{hys}				100							mV	
I _I	Control inputs	V _{CC} = 0 to 5.5 V, V _I = V _{CC} or GND		±1			±1		±1		μA	
	A or B ports	V _{CC} = 2.1 V to 5.5 V, V _I = V _{CC} or GND		±20			±20		±20			
I _{OZPU}		V _{CC} = 0 to 2.1 V, V _O = 0.5 V to 2.7 V, $\overline{OE}$ or OE = X [§]		±50			±50		±50		μA	
I _{OZPD}		V _{CC} = 2.1 V to 0, V _O = 0.5 V to 2.7 V, $\overline{OE}$ or OE = X [§]		±50			±50		±50		μA	
I _{OZH} [‡]		V _{CC} = 2.1 V to 5.5 V, V _O = 2.7 V, $\overline{OE} \geq 2$ V or OE ≤ 0.8 V		10			10		10		μA	
I _{OZL} [‡]		V _{CC} = 2.1 V to 5.5 V, V _O = 0.5 V, $\overline{OE} \geq 2$ V or OE ≤ 0.8 V		-10			-10		-10		μA	
I _{off}		V _{CC} = 0, V _I or V _O ≤ 4.5 V		±100					±100		μA	
I _{CEX}	Outputs high	V _{CC} = 5.5 V, V _O = 5.5 V		50			50		50		μA	
I _O [¶]	A port	V _{CC} = 5.5 V, V _O = 2.5 V		-50	-110	-180	-50	-180	-50	-180	mA	
	B port	V _{CC} = 5.5 V, V _O = 2.5 V		-25	-55	-90	-25	-90	-25	-90		
I _{CC}	A or B ports	V _{CC} = 5.5 V, I _O = 0, V _I = V _{CC} or GND	Outputs high		3			3		3		mA
			Outputs low		36			36		36		
			Outputs disabled		3			3		3		
ΔI _{CC} [#]		V _{CC} = 5.5 V, One input at 3.4 V, Other inputs at V _{CC} or GND		50			50		50		μA	
C _i	Control inputs	V _I = 2.5 V or 0.5 V		3							pF	
C _{io}	A or B ports	V _O = 2.5 V or 0.5 V		9							pF	

* On products compliant to MIL-PRF-38535, this parameter does not apply.

† All typical values are at V_{CC} = 5 V.

‡ 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.

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

SN54ABT162501, SN74ABT162501 18-BIT UNIVERSAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS243E – SEPTEMBER 1992 – REVISED FEBRUARY 1999

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

				SN54ABT162501		SN74ABT162501		UNIT
				MIN	MAX	MIN	MAX	
f _{clock}	Clock frequency			150		150		MHz
t _w	Pulse duration	LEAB or LEBA high		3		3		ns
		CLKAB or CLKBA high or low		3.3		3.3		
t _{su}	Setup time	A before CLKAB↑		4.3		4.3		ns
		B before CLKBA↑		4.3		4.3		
		A before LEAB↓ or B before LEBA↓	CLK high	2.5		2.5		
			CLK low	1		1		
t _h	Hold time	A after CLKAB↑ or B after CLKBA↑		0		0		ns
		A after LEAB↓ or B after LEBA↓		2		2		

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, $T_A = 25^\circ\text{C}$			SN54ABT162501		SN74ABT162501		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			150	200		150		150		MHz
t_{PLH}	A or B	B or A	1.5	2.6	4	1.5	5.1	1.5	4.8	ns
t_{PHL}			2	3.4	5.2	2	6.1	2	5.7	
t_{PLH}	LEAB or LEBA	B or A	2	3.3	4.8	2	6.1	2	5.6	ns
t_{PHL}			2	3.8	5.2	2	6.4	2	5.9	
t_{PLH}	CLKAB or CLKBA	B or A	1.5	3.5	4.7	1.5	6	1.5	5.5	ns
t_{PHL}			1.5	3.5	4.8	1.5	5.8	1.5	5.3	
t_{PZH}	OEAB or $\overline{\text{OEBA}}$	B or A	1.5	3.4	4.6	1.5	5.6	1.5	5.3	ns
t_{PZL}			2	3.8	4.7	2	5.6	2	5.4	
t_{PHZ}	OEAB or $\overline{\text{OEBA}}$	B or A	2	4.5	5.7	2	6.9	2	6.5	ns
t_{PLZ}			1.5	3.8	5.3	1.5	6.3	1.5	5.8	

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

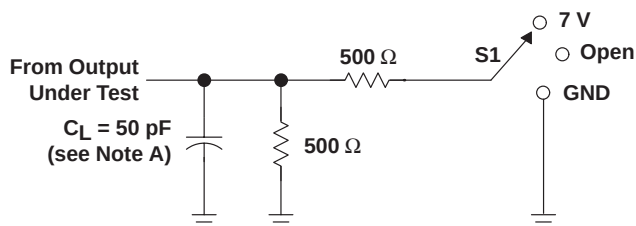
SN54ABT162501, SN74ABT162501

18-BIT UNIVERSAL BUS TRANSCEIVERS

WITH 3-STATE OUTPUTS

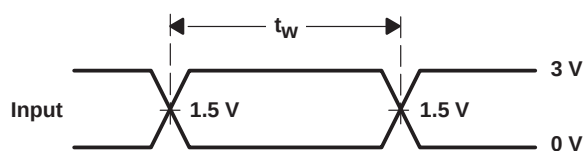
SCBS243E – SEPTEMBER 1992 – REVISED FEBRUARY 1999

PARAMETER MEASUREMENT INFORMATION

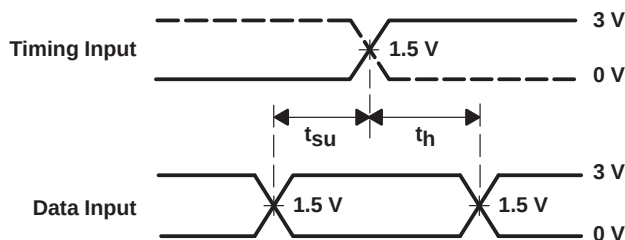


LOAD CIRCUIT

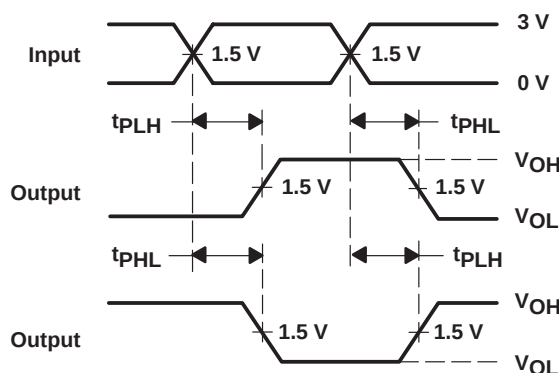
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open



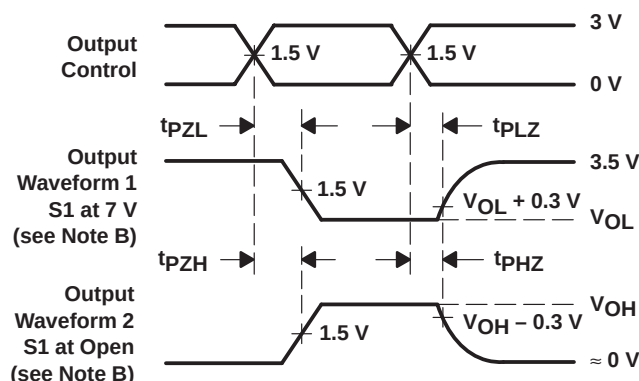
VOLTAGE WAVEFORMS
PULSE DURATION



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 ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/ Ball Finish	MSL Peak Temp ⁽³⁾	Samples (Requires Login)
74ABT162501DGGRE4	ACTIVE	TSSOP	DGG	56		TBD	Call TI	Call TI	
74ABT162501DGGRG4	ACTIVE	TSSOP	DGG	56		TBD	Call TI	Call TI	
74ABT162501DLRG4	ACTIVE	SSOP	DL	56		TBD	Call TI	Call TI	
SN74ABT162501DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT162501DLG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	

⁽¹⁾ 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.

⁽²⁾ 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)

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

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Transportation and Automotive	www.ti.com/automotive
Video and Imaging	www.ti.com/video
Wireless	www.ti.com/wireless-apps

TI E2E Community Home Page

e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2011, Texas Instruments Incorporated