

# SN54ABT16651, SN74ABT16651 16-BIT BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

OCTOBER 1992

- Members of the Texas Instruments *Widebus*™ Family
- State-of-the-Art *EPIC-IIB*™ BICMOS Design Significantly Reduces Power Dissipation
- Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17
- Typical  $V_{OLP}$  (Output Ground Bounce) < 1 V at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$
- Distributed  $V_{CC}$  and GND Pin Configuration Minimizes High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- High-Drive Outputs ( $-32\text{-mA } I_{OH}$ ,  $64\text{-mA } I_{OL}$ )
- Packaged in Plastic 300-mil Shrink Small-Outline Packages and 380-mil Fine-Pitch Ceramic Flat Packages Using 25-mil Center-to-Center Spacings

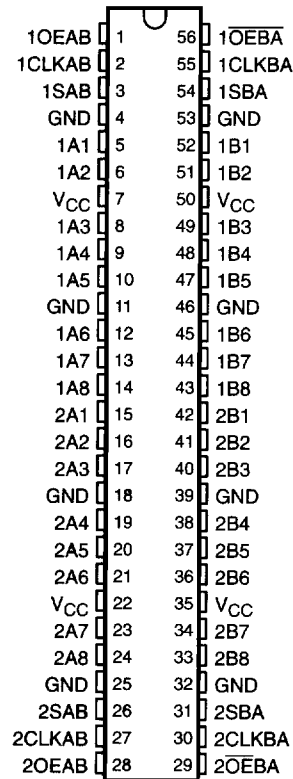
## description

The 'ABT16651 is a 16-bit bus transceiver that consists of D-type flip-flops and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. The device can be used as two 8-bit transceivers or one 16-bit transceiver.

Output-enable (OEAB and  $\overline{OEBA}$ ) inputs are provided to control the transceiver functions. Select-control (SAB and SBA) inputs are provided to select whether real-time or stored data is transferred. The circuitry used for select control eliminates the typical decoding glitch that occurs in a multiplexer during the transition between stored and real-time data. A low input selects real-time data, and a high input selects stored data. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the 'ABT16651.

Data on the A or B data bus, or both, can be stored in the internal D-type flip-flops by low-to-high transitions at the appropriate clock (CLKAB or CLKBA) inputs regardless of the select- or enable-control pins. When SAB and SBA are in the real-time transfer mode, it is possible to store data without using the internal D-type flip-flops by simultaneously enabling OEAB and  $\overline{OEBA}$ . In this configuration each output reinforces its input. Therefore, when all other data sources to the two sets of bus lines are at high impedance, each set of bus lines remain at its last state.

SN54ABT16651 . . . WD PACKAGE  
SN74ABT16651 . . . DL PACKAGE  
(TOP VIEW)



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**description (continued)**

To ensure the high-impedance state during power up or power down,  $\overline{OEBA}$  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).

The SN74ABT16651 is available 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.

The SN54ABT16651 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ABT16651 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

**FUNCTION TABLE**

INPUTS						DATA I/O		OPERATION OR FUNCTION
OEAB	$\overline{OEBA}$	CLKAB	CLKBA	SAB	SBA	A1 THRU A8	B1 THRU B8	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	↑	↑	X	X	Input	Input	Store A and B data
X	H	↑	H or L	X	X	Input	Unspecified†	Store A, hold B
H	H	↑	↑	X‡	X	Input	Output	Store A in both registers
L	X	H or L	↑	X	X	Unspecified†	Input	Hold A, store B
L	L	↑	↑	X	X‡	Output	input	Store B in both registers
L	L	X	X	X	L	Output	Input	Real-time $\overline{B}$ data to A bus
L	L	X	H or L	X	H	Output	Output	Stored $\overline{B}$ data to A bus
H	H	X	X	L	X	Input	Output	Real-time $\overline{A}$ data to B bus
H	H	H or L	X	H	X	Input	Output	Stored $\overline{A}$ data to B bus
H	L	H or L	H or L	H	H	Output	Output	Stored $\overline{A}$ data to B bus and stored B data to A bus

† The data output functions may be enabled or disabled by various signals at the OEAB or  $\overline{OEBA}$  inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every low-to-high transition on the clock inputs.

‡ When select control is low, clocks can occur simultaneously so long as allowances are made for propagation delays from A to B (B to A) plus setup and hold times. When select control is high, clocks must be staggered in order to load both registers.

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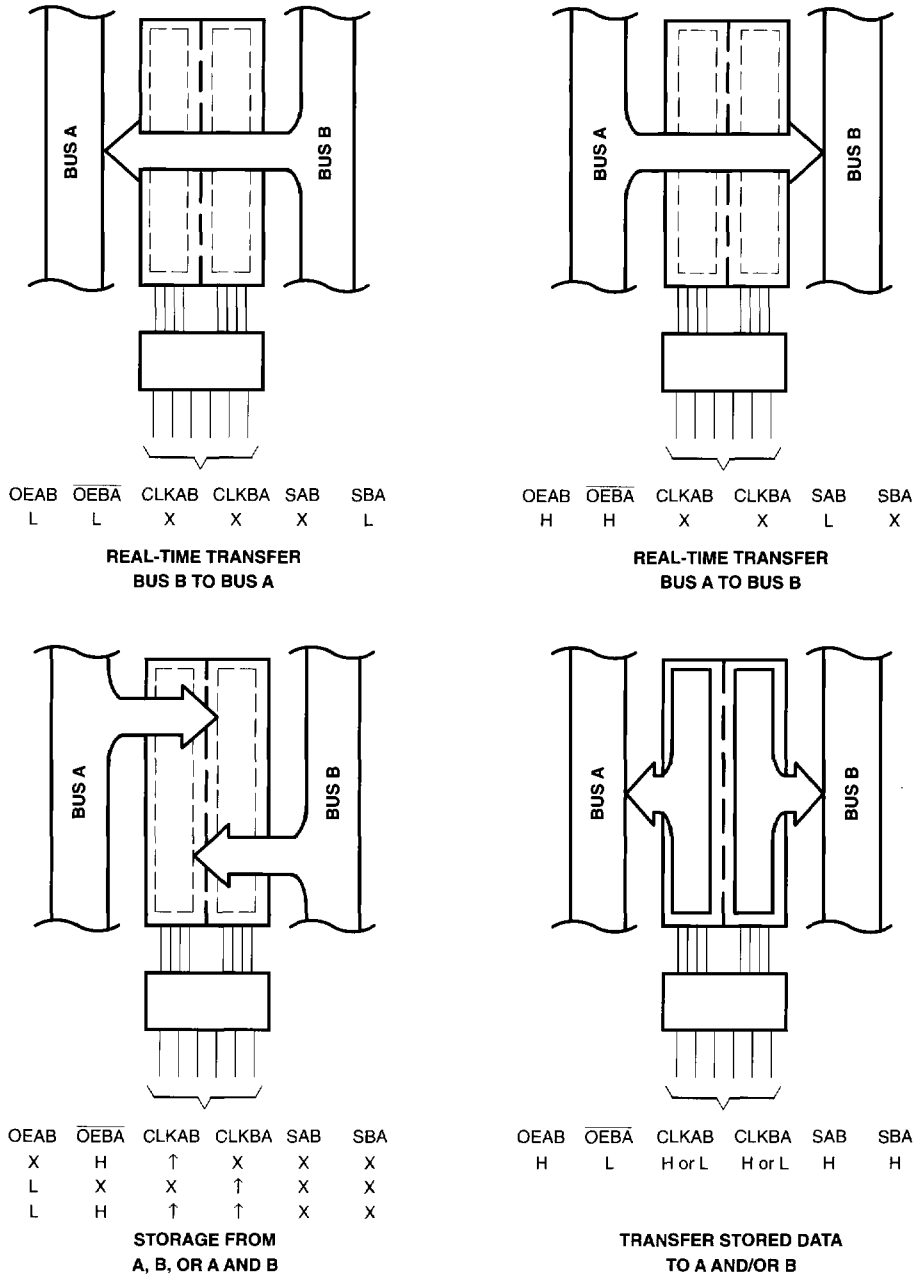


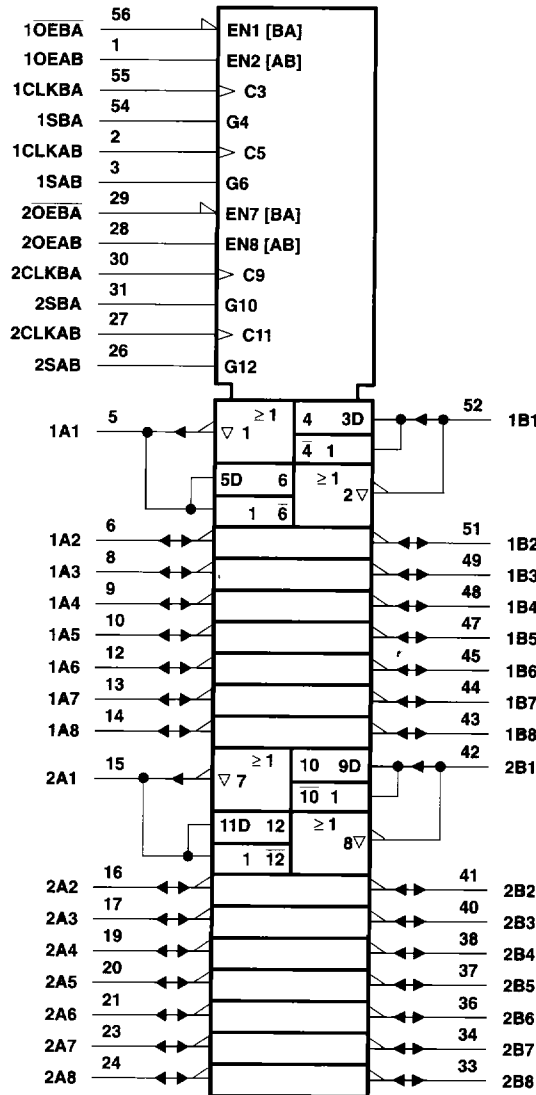
Figure 1. Bus-Management Functions

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logic symbol†

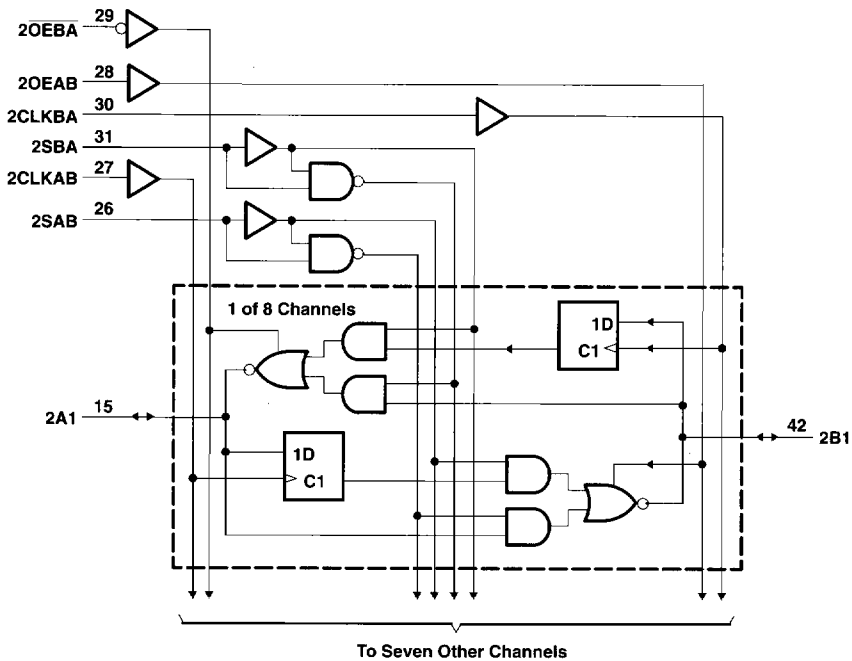
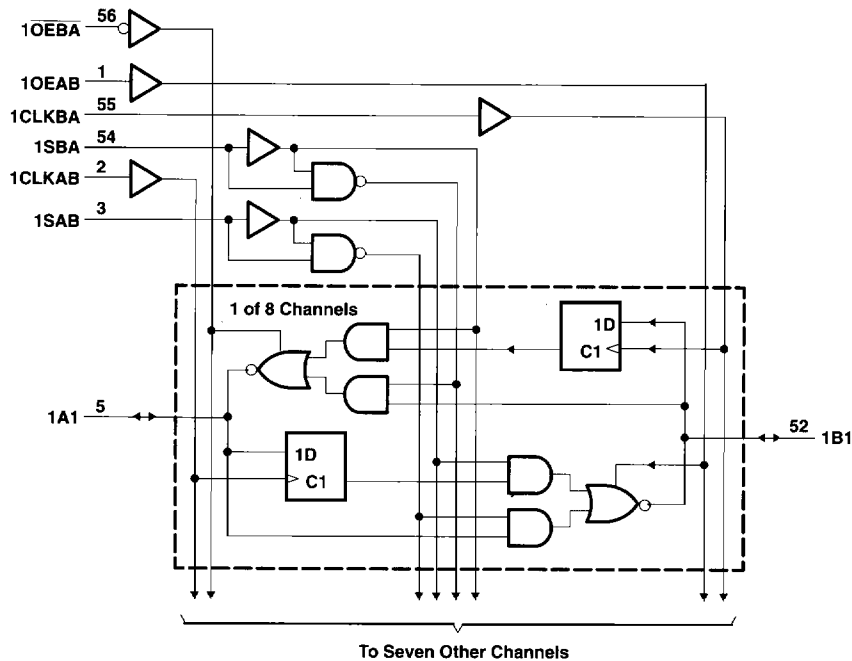


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† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.



logic diagram (positive logic)



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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 state or power-off state, $V_O$ .....	-0.5 V to 5.5 V
Current into any output in the low state, $I_O$ : SN54ABT16651 .....	96 mA
SN74ABT16651 .....	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 $T_A = 55^\circ\text{C}$ (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)**

		SN54ABT16651		SN74ABT16651		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.

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

PARAMETER	TEST CONDITIONS		T <sub>A</sub> = 25°C			SN54ABT16651		SN74ABT16651		UNIT		
			MIN	TYP†	MAX	MIN	MAX	MIN	MAX			
V <sub>IK</sub>	V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA				-1.2		-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, I <sub>OH</sub> = -24 mA				2							
	V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -32 mA				2‡			2				
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 48 mA				0.55			0.55		V		
	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 64 mA				0.55‡			0.55				
I <sub>I</sub>	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND		Control inputs			±1			±1	µA		
			A or B ports			±100			±100			
I <sub>OZH</sub> §	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.7 V				50			50	50	µA		
I <sub>OZL</sub> §	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0.5 V				-50			-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			±100	±100	µA		
I <sub>CEX</sub>	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 5.5 V		Outputs high		50			50	50	µA		
I <sub>O</sub> ¶	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.5 V		-50	-100	-180	-50	-180	-50	-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		A or B ports	Outputs high			2			2	mA	
				Outputs low			72			72		30
				Outputs disabled			2			2		2
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		Data inputs	Outputs enabled			1			1.5	mA	
				Outputs disabled			0.05			0.05		0.05
			Control inputs			1.5			1.5			1.5
C <sub>i</sub>	V <sub>I</sub> = 2.5 V or 0.5 V		Control inputs						pF			
C <sub>io</sub>	V <sub>O</sub> = 2.5 V or 0.5 V		A or B ports						pF			

† All typical values are at V<sub>CC</sub> = 5 V.

‡ On products compliant to MIL-STD-883, Class B, this parameter does not apply.

§ The parameters I<sub>OZH</sub> and I<sub>OZL</sub> 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<sub>CC</sub> or GND.

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