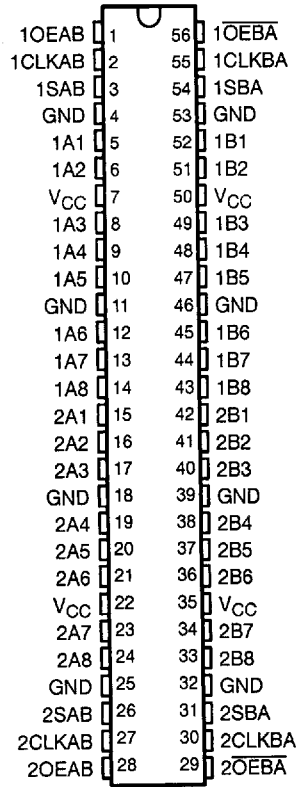


# SN54LVT16652, SN74LVT16652 3.3-V ABT 16-BIT BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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- State-of-the-Art Advanced BICMOS Technology (ABT) Design for 3.3-V Operation and Low-Static Power Dissipation
- Members of the Texas Instruments *Widebus™* Family
- Support Mixed-Mode Signal Operation (5-V Input and Output Voltages With 3.3-V  $V_{CC}$ )
- Support Unregulated Battery Operation Down to 2.7 V
- Typical  $V_{OLP}$  (Output Ground Bounce) < 0.8 V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- 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
- Bus-Hold Data Inputs Eliminate the Need for External Pullup Resistors
- Support Live Insertion
- Distributed  $V_{CC}$  and GND Pin Configuration Minimizes High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- Package Options Include Plastic 300-mil 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

SN54LVT16652 ... WD PACKAGE  
SN74LVT16652 ... DGG OR DL PACKAGE  
(TOP VIEW)



PRODUCT PREVIEW

## description

The 'LVT16652 are 16-bit bus transceivers designed for low-voltage (3.3-V)  $V_{CC}$  operation, but with the capability to provide a TTL interface to a 5-V system environment. These devices can be used as two 8-bit transceivers or one 16-bit transceiver.

Complementary 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. A low input level selects real-time data, and a high input level selects stored data. 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. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the 'LVT16652.

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**SN54LVT16652, SN74LVT16652**  
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**WITH 3-STATE OUTPUTS**

SCBS150D - JULY 1994 - REVISED FEBRUARY 1996

**description (continued)**

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

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

To ensure the high-impedance state during power up or power down, OE should be tied to V<sub>CC</sub> through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver. 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 SN74LVT16652 is available in TI's shrink small-outline (DL) and thin shrink small-outline (DGG) packages, which provide twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The SN54LVT16652 is characterized for operation over the full military temperature range of -55°C to 125°C. The SN74LVT16652 is characterized for operation from -40°C to 85°C.

**FUNCTION TABLE**

INPUTS						DATA I/O†		OPERATION OR FUNCTION
OEAB	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 B data to A bus
L	L	X	H or L	X	H	Output	Input	Stored B data to A bus
H	H	X	X	L	X	Input	Output	Real-time A data to B bus
H	H	H or L	X	H	X	Input	Output	Stored A data to B bus
H	L	H or L	H or L	H	H	Output	Output	Stored A data to B bus and stored B data to A bus

† The data output functions may be enabled or disabled by a variety of level combinations at OEAB or OEBA. Data input functions are always enabled; i.e., data at the bus pins is stored on every low-to-high transition on the clock inputs.

‡ Select control = L; clocks can occur simultaneously.

Select control = H; clocks must be staggered in order to load both registers.

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SN54LVT16652, SN74LVT16652  
 3.3-V ABT 16-BIT BUS TRANSCEIVERS AND REGISTERS  
 WITH 3-STATE OUTPUTS

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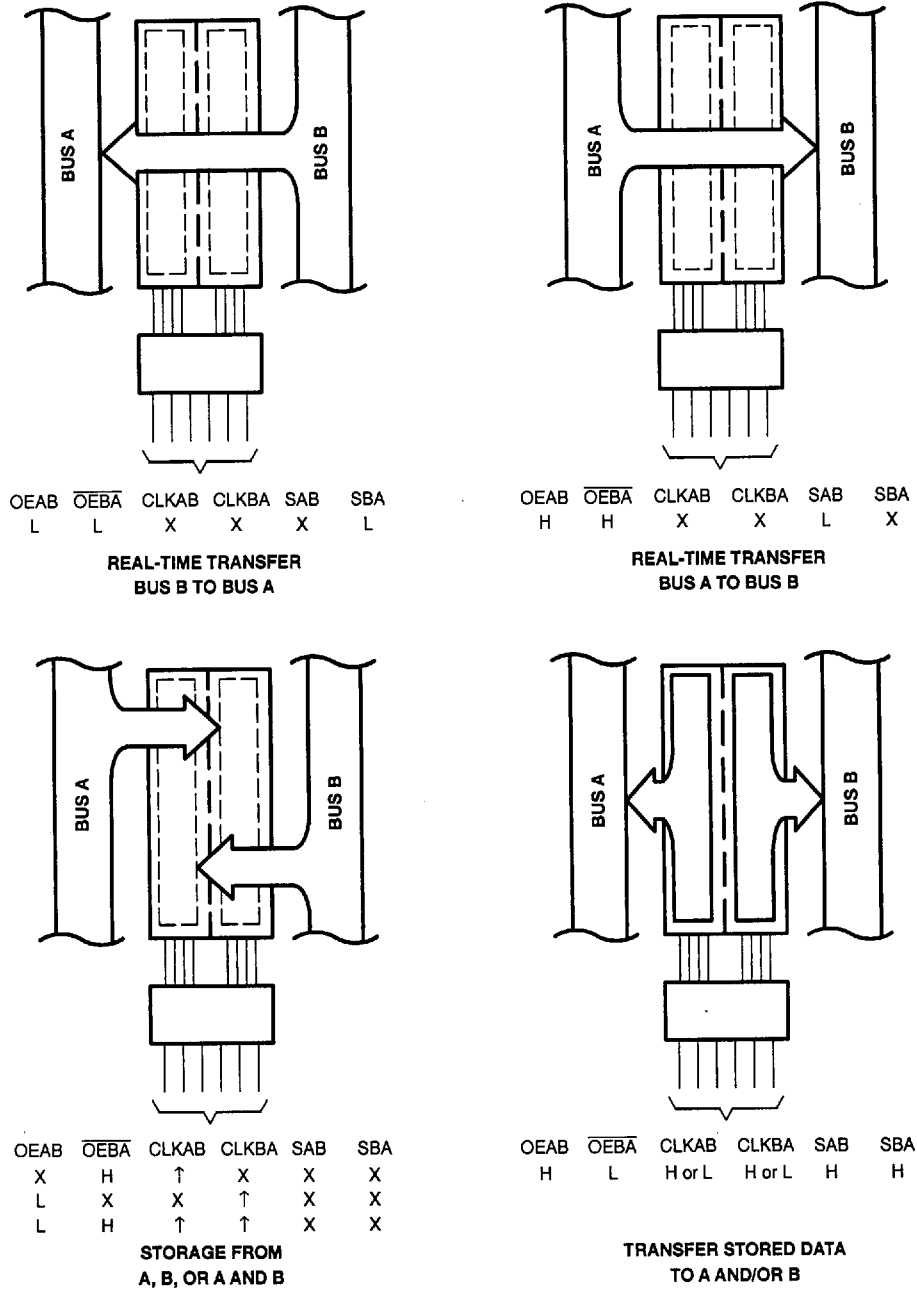


Figure 1. Bus-Management Functions

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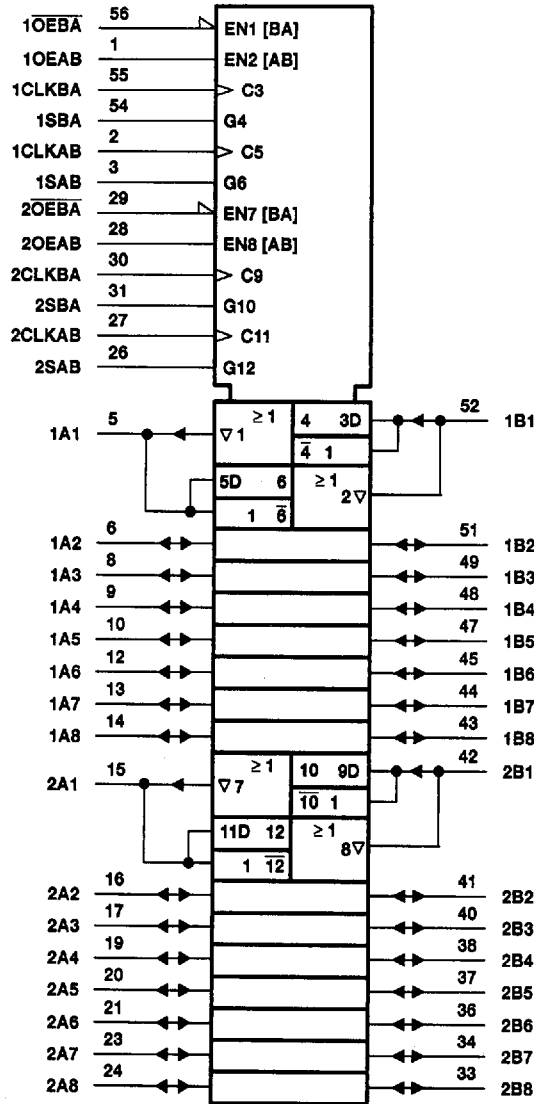


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**SN54LVT16652, SN74LVT16652**  
**3.3-V ABT 16-BIT BUS TRANSCEIVERS AND REGISTERS**  
**WITH 3-STATE OUTPUTS**

SCBS150D - JULY 1994 - REVISED FEBRUARY 1996

logic symbol†



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

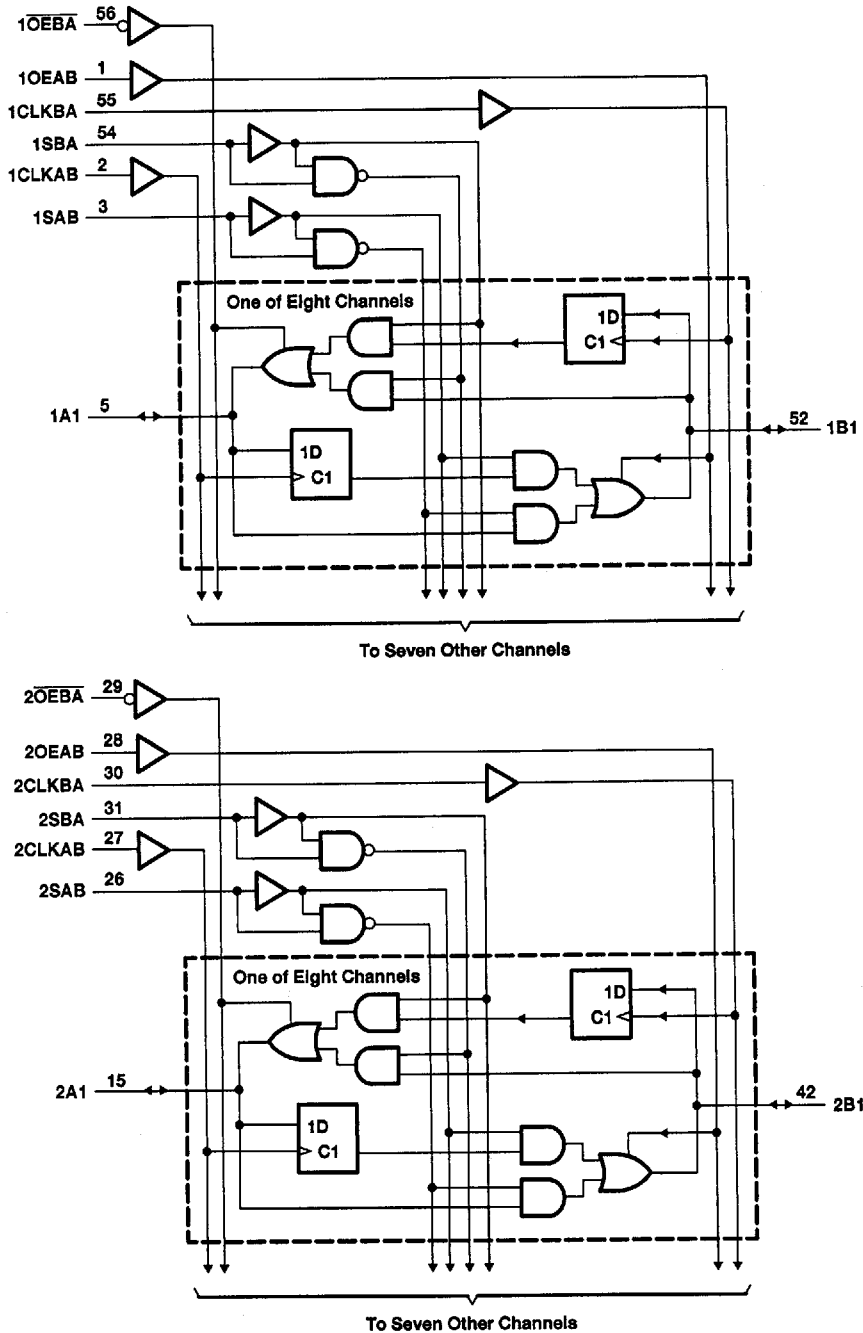


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SN54LVT16652, SN74LVT16652  
 3.3-V ABT 16-BIT BUS TRANSCEIVERS AND REGISTERS  
 WITH 3-STATE OUTPUTS

SCBS150D - JULY 1994 - REVISED FEBRUARY 1996

logic diagram (positive logic)



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**SN54LVT16652, SN74LVT16652**  
**3.3-V ABT 16-BIT BUS TRANSCEIVERS AND REGISTERS**  
**WITH 3-STATE OUTPUTS**

SCBS150D - JULY 1994 - REVISED FEBRUARY 1996

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

Supply voltage range, $V_{CC}$ .....	-0.5 V to 4.6 V
Input voltage range, $V_I$ (see Note 1) .....	-0.5 V to 7 V
Voltage range applied to any output in the high state or power-off state, $V_O$ (see Note 1) .....	-0.5 V to 7 V
Current into any output in the low state, $I_O$ : SN54LVT16652 .....	96 mA
SN74LVT16652 .....	128 mA
Current into any output in the high state, $I_O$ (see Note 2): SN54LVT16652 .....	48 mA
SN74LVT16652 .....	64 mA
Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....	-50 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ ) .....	-50 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 3): DGG package .....	1 W
DL package .....	1.4 W
Storage temperature range, $T_{stg}$ .....	$-65^\circ\text{C}$ to $150^\circ\text{C}$

† 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. This current flows only when the output is in the high state and  $V_O > V_{CC}$ .  
 3. The maximum package power dissipation is calculated using a junction temperature of  $150^\circ\text{C}$  and a board trace length of 750 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 4)**

		SN54LVT16652		SN74LVT16652		UNIT	
		MIN	MAX	MIN	MAX		
$V_{CC}$	Supply voltage	2.7	3.6	2.7	3.6	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		5.5		5.5	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		10		10	ns/V	
$T_A$	Operating free-air temperature		-55	125	-40	85	$^\circ\text{C}$

NOTE 4: Unused control inputs must be held high or low to prevent them from floating.

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**SN54LVT16652, SN74LVT16652**  
**3.3-V ABT 16-BIT BUS TRANSCEIVERS AND REGISTERS**  
**WITH 3-STATE OUTPUTS**

SCBS150D - JULY 1994 - REVISED FEBRUARY 1996

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

PARAMETER	TEST CONDITIONS		SN54LVT16652			SN74LVT16652			UNIT
			MIN	TYPT†	MAX	MIN	TYPT†	MAX	
$V_{IK}$	$V_{CC} = 2.7 V$ ,	$I_I = -18 mA$			-1.2			-1.2	V
$V_{OH}$	$V_{CC} = \text{MIN to MAX}^\ddagger$ ,	$I_{OH} = -100 \mu A$	$V_{CC} - 0.2$		$V_{CC} - 0.2$				V
	$V_{CC} = 2.7 V$ ,	$I_{OH} = -8 mA$	2.4		2.4				
	$V_{CC} = 3 V$	$I_{OH} = -24 mA$ $I_{OH} = -32 mA$	2		2				
$V_{OL}$	$V_{CC} = 2.7 V$	$I_{OL} = 100 \mu A$			0.2			0.2	V
		$I_{OL} = 24 mA$			0.5			0.5	
	$V_{CC} = 3 V$	$I_{OL} = 16 mA$			0.4			0.4	
		$I_{OL} = 32 mA$			0.5			0.5	
		$I_{OL} = 48 mA$			0.55				
		$I_{OL} = 64 mA$						0.55	
$I_I$	$V_{CC} = 3.6 V$ ,	$V_I = V_{CC}$ or GND	Control inputs		$\pm 1$		$\pm 1$	$\mu A$	
	$V_{CC} = 0$ or $\text{MAX}^\ddagger$ ,	$V_I = 5.5 V$			10		10		
	$V_{CC} = 3.6 V$	$V_I = 5.5 V$	A or B ports§		20		20		
		$V_I = V_{CC}$ $V_I = 0$			5 -10		5 -10		
$I_{off}$	$V_{CC} = 0$ ,	$V_I$ or $V_O = 0$ to 4.5 V					$\pm 100$	$\mu A$	
$I_I(\text{hold})$	$V_{CC} = 3 V$	$V_I = 0.8 V$	A or B ports		75		75	$\mu A$	
		$V_I = 2 V$			-75		-75		
$I_{OZH}$	$V_{CC} = 3.6 V$ ,	$V_O = 3 V$			1		1	$\mu A$	
$I_{OZL}$	$V_{CC} = 3.6 V$ ,	$V_O = 0.5 V$			-1		-1	$\mu A$	
$I_{CC}$	$V_{CC} = 3.6 V$ , $V_I = V_{CC}$ or GND	$I_O = 0$ ,	Outputs high		0.1		0.1	mA	
			Outputs low		5		5		
			Outputs disabled		0.1		0.1		
$\Delta I_{CC}^\parallel$	$V_{CC} = 3 V$ to 3.6 V, Other inputs at $V_{CC}$ or GND	One input at $V_{CC} - 0.6 V$ ,			0.2		0.2	mA	
$C_i$	$V_I = 3 V$ or 0				3.5		3.5	pF	
$C_{io}$	$V_O = 3 V$ or 0				12		12	pF	

† All typical values are at  $V_{CC} = 3.3 V$ ,  $T_A = 25^\circ C$ .

‡ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

§ Unused pins at  $V_{CC}$  or GND

¶ This is the increase in supply current for each input that is at the specified TTL voltage level rather than  $V_{CC}$  or GND.

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