

# SN74LVC4245

## OCTAL BUS TRANSCEIVER AND 3.3-V TO 5-V SHIFTER WITH 3-STATE OUTPUTS

SCAS375A – MARCH 1994 – REVISED JULY 1995

- **EPIC™ (Enhanced-Performance Implanted CMOS) Submicron Process**
- **3.3-V to 5-V Bidirectional Level Shifter**
- **Package Options Include Plastic Small-Outline (DW), Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages**

### description

This 8-bit (octal) noninverting bus transceiver contains two separate supply rails; B port has  $V_{CCB}$ , which is set at 3.3 V, and A port has  $V_{CCA}$ , which is set to operate at 5 V. This allows for translation from a 3.3-V to a 5-V environment and vice versa.

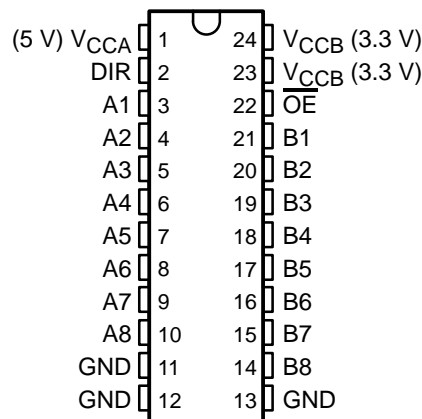
The SN74LVC4245 is designed for asynchronous communication between data buses. The device transmits data from the A bus to the B bus or from the B bus to the A bus, depending upon the logic level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the device so the buses are effectively isolated.

The SN74LVC4245 pinout allows the designer to switch to a normal all-3.3-V or all-5-V 20-pin '245 device without board re-layout. The designer uses the datapaths for pins 2 through 11 and 14 through 23 of the SN74LVC4245 to achieve the conventional '245 layout.

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

The SN74LVC4245 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

DB, DW, OR PW PACKAGE  
(TOP VIEW)



FUNCTION TABLE

INPUTS		OPERATION
$\overline{OE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation



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.

EPIC is a trademark of Texas Instruments Incorporated.

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

Copyright © 1995, Texas Instruments Incorporated

PRODUCT PREVIEW

## SCAS375A – MARCH 1994 – REVISED JULY 1995

Logic diagram of a 2-to-4 decoder circuit. The circuit has two inputs: DIR (pin 2) and A1 (pin 3). It has two outputs: B1 (pin 21) and OE (pin 22). The circuit consists of two AND gates, two inverters, and two OR gates. The first AND gate has inputs DIR and A1. The second AND gate has inputs DIR and the output of an inverter connected to A1. The outputs of the AND gates are connected to the inputs of two OR gates. The output of the first OR gate is B1, and the output of the second OR gate is OE. The circuit is labeled "To Seven Other Channels" at the bottom.

Supply voltage range, $V_{CCA}$	.....	-0.5 V to 6.5 V
Input voltage range, $V_I$ (see Note 1)	.....	-0.5 V to $V_{CCA} + 0.5$ V
Output voltage range, $V_O$ (see Note 1)	.....	-0.5 V to $V_{CCA} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CCA}$ )	.....	-50 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CCA}$ )	.....	$\pm 50$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CCA}$ )	.....	$\pm 50$ mA
Continuous current through each $V_{CCA}$ or GND	.....	$\pm 100$ mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2):		
	DB package	0.65 W
	DW package	1.7 W
	PW package	0.7 W
Storage temperature range, $T_{\text{stg}}$	.....	$-65^\circ\text{C}$ to $150^\circ\text{C}$

NOTES: 1. This value is limited to 6 V maximum.

2. The maximum package power dissipation is calculated using a junction temperature of 150°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.

# SN74LVC4245

## OCTAL BUS TRANSCEIVER AND 3.3-V TO 5-V SHIFTER

### WITH 3-STATE OUTPUTS

SCAS375A – MARCH 1994 – REVISED JULY 1995

**absolute maximum ratings over operating free-air temperature range for  $V_{CCB}$  at 3.3 V (unless otherwise noted)<sup>†</sup>**

Supply voltage range, $V_{CCB}$	–0.5 V to 4.6 V
Input voltage range, $V_I$ (except I/O ports) (see Note 3)	–0.5 V to 4.6 V
Input voltage range, $V_I$ (I/O ports) (see Note 3)	–0.5 V to $V_{CCB} + 0.5$ V
Output voltage range, $V_O$ (see Note 3)	–0.5 V to $V_{CCB} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ )	–50 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CCB}$ )	±50 mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CCB}$ )	±50 mA
Continuous current through $V_{CCB}$ or GND	±100 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): DB package	0.65 W
DW package	1.7 W
PW package	0.7 W
Storage temperature range, $T_{stg}$	–65°C to 150°C

<sup>†</sup> 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: 2. The maximum package power dissipation is calculated using a junction temperature of 150°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.
3. This value is limited to 4.6 V maximum.

**recommended operating conditions for  $V_{CCA}$  at 5 V (see Note 3)**

	MIN	MAX	UNIT
$V_{CCA}$ Supply voltage	4.5	5.5	V
$V_{IH}$ High-level input voltage	2		V
$V_{IL}$ Low-level input voltage		0.8	V
$V_I$ Input voltage	0	$V_{CCA}$	V
$V_O$ Output voltage	0	$V_{CCA}$	V
$I_{OH}$ High-level output current		–24	mA
$I_{OL}$ Low-level output current		24	mA
$\Delta t/\Delta v$ Input transition rise or fall rate	0	10	ns/V
$T_A$ Operating free-air temperature	–40	85	°C

NOTE 3: Unused inputs must be held high or low to prevent them from floating.

**recommended operating conditions for  $V_{CCB}$  at 3.3 V (see Note 3)**

	MIN	MAX	UNIT
$V_{CCB}$ Supply voltage	2.7	3.6	V
$V_{IH}$ High-level input voltage	$V_{CCB} = 2.7$ V to 3.6 V		2
$V_{IL}$ Low-level input voltage	$V_{CCB} = 2.7$ V to 3.6 V		0.8
$V_I$ Input voltage	0	$V_{CCB}$	V
$V_O$ Output voltage	0	$V_{CCB}$	V
$I_{OH}$ High-level output current	$V_{CCB} = 2.7$ V		–12
	$V_{CCB} = 3$ V		–24
$I_{OL}$ Low-level output current	$V_{CCB} = 2.7$ V		12
	$V_{CCB} = 3$ V		24
$\Delta t/\Delta v$ Input transition rise or fall rate	0	10	ns/V
$T_A$ Operating free-air temperature	–40	85	°C

NOTE 3: Unused inputs must be held high or low to prevent them from floating.



# SN74LVC4245

## OCTAL BUS TRANSCEIVER AND 3.3-V TO 5-V SHIFTER

### WITH 3-STATE OUTPUTS

SCAS375A – MARCH 1994 – REVISED JULY 1995

**electrical characteristics over recommended operating free-air temperature range for  $V_{CCA} = 5\text{ V}$  (unless otherwise noted) (see Note 4)**

PARAMETER		TEST CONDITIONS	$V_{CCA}$	MIN	TYP <sup>†</sup>	MAX	UNIT
$V_{OH}$		$I_{OH} = -100\text{ }\mu\text{A}$	4.5 V	4.3			V
			5.5 V	5.3			
		$I_{OH} = -24\text{ mA}$	4.5 V	3.7			
			5.5 V	4.7			
$V_{OL}$		$I_{OL} = 100\text{ }\mu\text{A}$	4.5 V			0.2	V
			5.5 V			0.2	
		$I_{OL} = 24\text{ mA}$	4.5 V			0.55	
			5.5 V			0.55	
$I_I$	Control inputs	$V_I = V_{CCA}$ or GND	5.5 V			5	$\mu\text{A}$
$I_{OZ}^{\ddagger}$	A or B ports	$V_O = V_{CCA}$ or GND	5.5 V				$\mu\text{A}$
$I_{CC}$		$V_I = V_{CCA}$ or GND, $I_O = 0$	5.5 V				$\mu\text{A}$
$\Delta I_{CC}^{\S}$		One input at 3.4 V, Other inputs at $V_{CCA}$ or GND					$\mu\text{A}$
$C_i$	Control inputs	$V_I = V_{CCA}$ or GND	5 V				pF
$C_{io}$	A or B ports	$V_O = V_{CCA}$ or GND	5 V				pF

<sup>†</sup> All typical values are measured at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

<sup>‡</sup> For I/O ports, the parameter  $I_{OZ}$  includes the input leakage current.

<sup>§</sup> This is the increase in supply current for each input that is at one of the specified TTL voltage levels rather than 0 V or the corresponding  $V_{CC}$ .

NOTE 4:  $V_{CCB} = 2.7\text{ V}$  to  $3.6\text{ V}$

**electrical characteristics over recommended operating free-air temperature range for  $V_{CCB} = 3.3\text{ V}$  (unless otherwise noted) (see Note 5)**

PARAMETER		TEST CONDITIONS	$V_{CCB}^{\P}$	MIN	TYP <sup>†</sup>	MAX	UNIT
$V_{OH}$		$I_{OH} = -100\text{ }\mu\text{A}$	MIN to MAX	$V_{CC} - 0.2$			V
		$I_{OH} = -12\text{ mA}$	2.7 V	2.2			
		$I_{OH} = -24\text{ mA}$	3 V	2.4			
			3 V	2			
$V_{OL}$		$I_{OL} = 100\text{ }\mu\text{A}$	MIN to MAX			0.2	V
		$I_{OL} = 12\text{ mA}$	2.7 V			0.4	
		$I_{OL} = 24\text{ mA}$	3 V			0.55	
$I_I$	Control inputs	$V_I = V_{CCB}$ or GND	3.6 V			5	$\mu\text{A}$
$I_{OZ}^{\ddagger}$		$V_O = V_{CCB}$ or GND	3.6 V				$\mu\text{A}$
$I_{CC}$		$V_I = V_{CCB}$ or GND, $I_O = 0$	3.6 V				$\mu\text{A}$
$\Delta I_{CC}^{\S}$		One input at $V_{CCB} - 0.6\text{ V}$ , Other inputs at $V_{CCB}$ or GND	2.7 V to 3.6 V				$\mu\text{A}$
$C_i$	Control inputs	$V_I = V_{CCB}$ or GND	3.3 V				pF
$C_{io}$	A or B ports	$V_O = V_{CCB}$ or GND	3.3 V				pF

<sup>†</sup> All typical values are measured at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

<sup>‡</sup> For I/O ports, the parameter  $I_{OZ}$  includes the input leakage current.

<sup>§</sup> This is the increase in supply current for each input that is at one of the specified TTL voltage levels rather than 0 V or the corresponding  $V_{CC}$ .

<sup>\P</sup> For conditions shown as MIN or MAX, use the appropriate values under recommended operating conditions.

NOTE 5:  $V_{CCA} = 5\text{ V} \pm 0.5\text{ V}$

PRODUCT PREVIEW



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

## **IMPORTANT NOTICE**

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

TI warrants performance of its semiconductor products and related software to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Certain applications using semiconductor products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications").

**TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS.**

Inclusion of TI products in such applications is understood to be fully at the risk of the customer. Use of TI products in such applications requires the written approval of an appropriate TI officer. Questions concerning potential risk applications should be directed to TI through a local SC sales office.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TI warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.