

SN74ALVC164245

16-BIT 3.3-V TO 5-V LEVEL SHIFTING TRANSCEIVER WITH 3-STATE OUTPUTS

SCAS416A – MARCH 1994 – REVISED DECEMBER 1995

- Member of the Texas Instruments *Widebus™* Family
- EPIC™ (Enhanced-Performance Implanted CMOS) Submicron Process
- Latch-Up Performance Exceeds 250 mA Per JEDEC Standard JESD-17
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages

description

This 16-bit (dual-octal) noninverting bus transceiver contains two separate supply rails; B port has V_{CCB} , which is set at 5 V, and A port has V_{CCA} , which is set to operate at 3.3 V. This allows for translation from a 3.3-V to a 5-V environment and vice-versa.

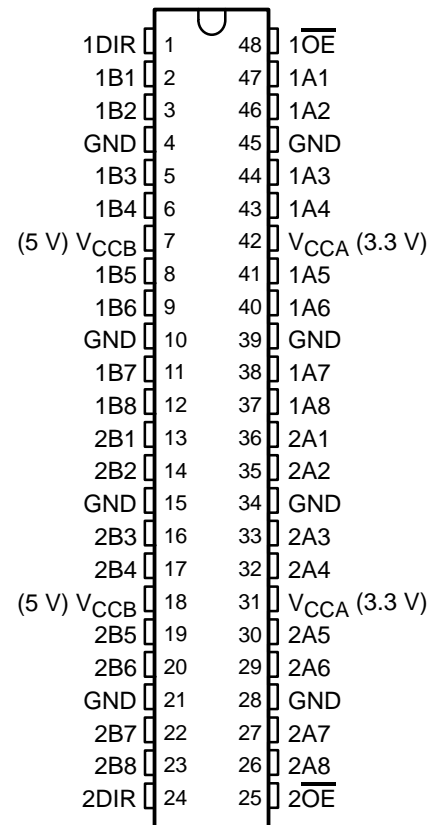
The SN74ALVC164245 is designed for asynchronous communication between data buses.

The SN74ALVC164245 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.

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 SN74ALVC164245 is characterized for operation from -40°C to 85°C .

DGG OR DL PACKAGE
(TOP VIEW)



FUNCTION TABLE
(each 8-bit section)

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



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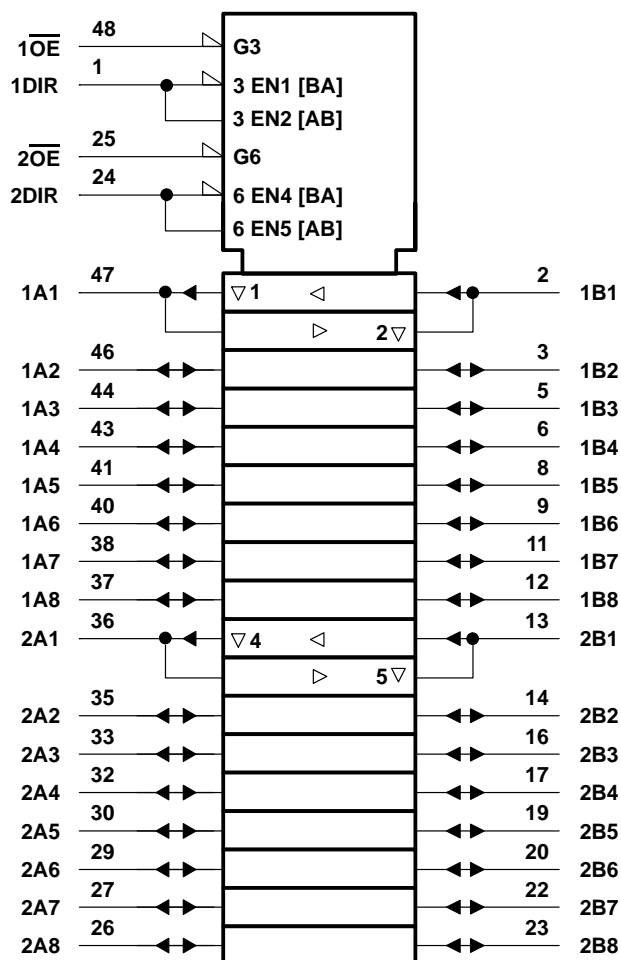
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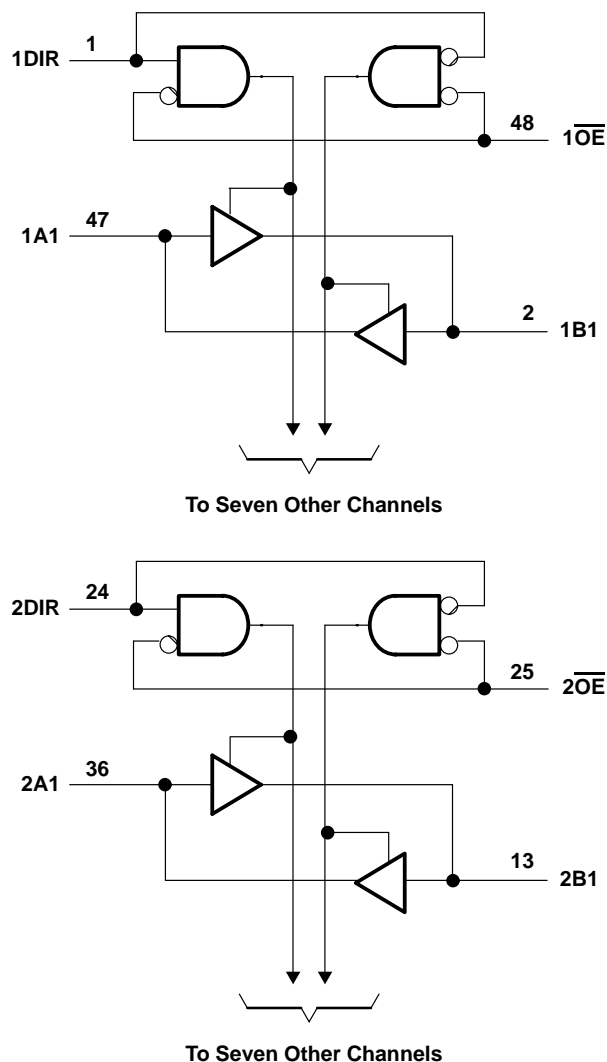
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logic symbol†



logic diagram (positive logic)



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

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absolute maximum ratings over operating free-air temperature range for V_{CCB} at 5 V (unless otherwise noted)[†]

Supply voltage range, V_{CCB}	–0.5 V to 6 V
Input voltage range, V_I (see Note 1)	–0.5 V to 6 V
Output voltage range, V_O (see Note 1)	–0.5 V to $V_{CCB} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CCB}$)	–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 each V_{CCB} or GND	±100 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): DGG package	0.85 W
DL package	1.2 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. 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.

absolute maximum ratings over operating free-air temperature range for V_{CCA} at 3.3 V (unless otherwise noted)[†]

Supply voltage range, V_{CCA}	–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
I/O ports (see Note 3)	–0.5 V to $V_{CCA} + 0.5$ V
Output voltage range, V_O (see Note 3)	–0.5 V to $V_{CCA} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$)	–50 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CCA}$)	±50 mA
Continuous output current, I_O ($V_O = 0$ to V_{CCA})	±50 mA
Continuous current through each V_{CCA} or GND	±100 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): DGG package	0.85 W
DL package	1.2 W
Storage temperature range, T_{stg}	–65°C to 150°C

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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.

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recommended operating conditions for V_{CCB} at 5 V (see Note 3)

	MIN	MAX	UNIT
V_{CCB} 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_{IA} Input voltage	0	V_{CCB}	V
V_{OB} Output voltage	0	V_{CCB}	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_{CCA} at 3.3 V (see Note 3)

			MIN	MAX	UNIT
V _{CCA}	Supply voltage		2.7	3.6	V
V _{IH}	High-level input voltage	V _{CCA} = 2.7 V to 3.6 V	2		V
V _{IL}	Low-level input voltage	V _{CCA} = 2.7 V to 3.6 V		0.8	V
V _{IB}	Input voltage		0	V _{CCA}	V
V _{OA}	Output voltage		0	V _{CCA}	V
I _{OH}	High-level output current	V _{CCA} = 2.7 V	−12		mA
		V _{CCA} = 3 V	−24		
I _{OL}	Low-level output current	V _{CCA} = 2.7 V	12		mA
		V _{CCA} = 3 V	24		
Δt/Δv	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.



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

PARAMETER		TEST CONDITIONS	V_{CCB}	MIN	TYP†	MAX	UNIT
V_{OH} (A to B)		$I_{OH} = -100\text{ }\mu\text{A}$	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} (A to B)		$I_{OL} = 100\text{ }\mu\text{A}$	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	$V_I = V_{CCB}$ or GND	5.5 V			± 5	μA
I_{OZ}^\ddagger	A or B ports	$V_O = V_{CCB}$ or GND	5.5 V				μA
I_{CC}		$V_I = V_{CCB}$ or GND, $I_O = 0$	5.5 V				μA
ΔI_{CC}^\S		One input at 3.4 V, Other inputs at V_{CCB} or GND	4.5 V to 5.5 V				μA
C_i	Control inputs	$V_I = V_{CCB}$ or GND	5 V		6.5		pF
C_{io}	A or B ports	$V_O = V_{CCB}$ or GND	5 V		6.5		pF

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

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

§ This is the increase in supply current for each input that is at one of the specified TTL voltage levels rather than at 0 V or V_{CCA} .

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

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

PARAMETER		TEST CONDITIONS	V_{CCA}^\P	MIN	TYP†	MAX	UNIT
V_{OH} (B to A)		$I_{OH} = -100\text{ }\mu\text{A}$	MIN to MAX	$V_{CC} - 0.2$			V
			2.7 V	2.2			
		$I_{OH} = -12\text{ mA}$	3 V	2.4			
			3 V	2			
V_{OL} (B to A)		$I_{OL} = 100\text{ }\mu\text{A}$	MIN to MAX			0.2	V
			2.7 V			0.4	
		$I_{OL} = 12\text{ mA}$	3 V			0.55	
			3 V			0.55	
I_I	Control inputs	$V_I = V_{CCA}$ or GND	3.6 V			± 5	μA
I_{OZ}^\ddagger		$V_O = V_{CCA}$ or GND	3.6 V			± 10	μA
I_{CC}		$V_I = V_{CCA}$ or GND, $I_O = 0$	3.6 V			40	μA
ΔI_{CC}^\S		One input at $V_{CCA} - 0.6\text{ V}$, Other inputs at V_{CCA} or GND	3 V to 3.6 V			750	μA
C_i	Control inputs	$V_I = V_{CCA}$ or GND	3.3 V		6.5		pF
C_{io}	A or B ports	$V_O = V_{CCA}$ or GND	3.3 V		8.5		pF

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

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

§ This is the increase in supply current for each input that is at one of the specified TTL voltage levels rather than at 0 V or V_{CCA} .

¶ For conditions shown as MIN or MAX, use the appropriate values under recommended operating conditions.

NOTE 5: $V_{CCB} = 5\text{ V} \pm .05\text{ V}$



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switching characteristics over recommended operating free-air temperature range, $C_L = 50$ pF (unless otherwise noted) (see Figures 1 and 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	VCCB = 5 V ± 0.5 V				UNIT
			VCCA = 2.7 V		VCCA = 3.3 V ± 0.3 V		
			MIN	MAX†	MIN†	MAX†	
t _{pd}	A	B	5.9		1	5.8	ns
	B	A	6.7		1.2	5.8	ns
t _{en}	\overline{OE}	B	9.3		1	8.9	ns
t _{dis}	\overline{OE}	B	9.2		2.1	9.5	ns
t _{en}	\overline{OE}	A	10.2		2	9.1	ns
t _{dis}	\overline{OE}	A	9		2.9	8.6	ns

† This datasheet limit can vary among suppliers.

operating characteristics, $T_A = 25^\circ\text{C}$

PARAMETER			TEST CONDITIONS	V _{CCA} = 3.3 V V _{CCB} = 5 V	UNIT
				TYP	
C _{pd}	Power dissipation capacitance	Outputs enabled (A or B)	C _L = 50 pF, f = 10 MHz	56	pF
		Outputs disabled (A or B)		6	

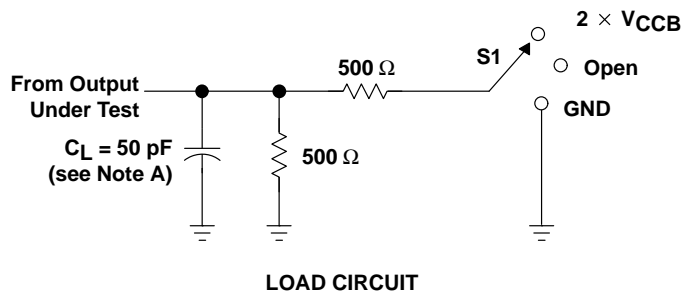
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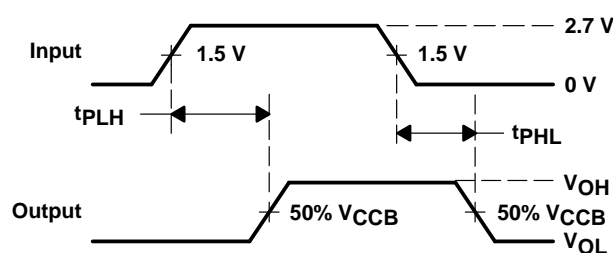
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PARAMETER MEASUREMENT INFORMATION

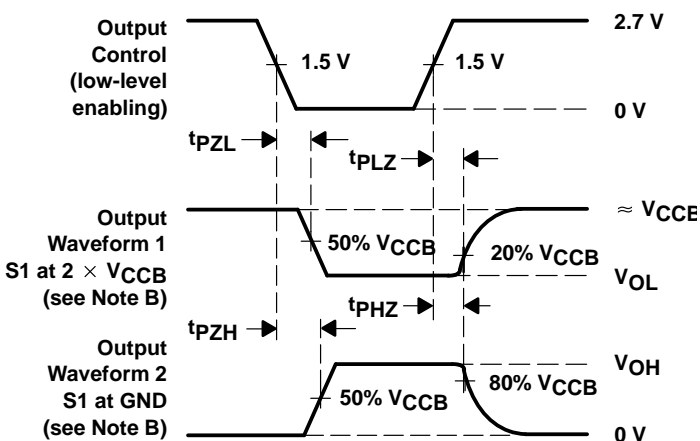
$$V_{CCB} = 5\text{ V} \pm 0.5\text{ V}$$



TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	2 $\times V_{CCB}$
t_{PHZ}/t_{PZH}	GND



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

- NOTES:
- C_L includes probe and jig capacitance.
 - 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.
 - All input pulses are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\text{ }\Omega$, $t_r \leq 2.5\text{ ns}$, $t_f \leq 2.5\text{ ns}$.
 - The outputs are measured one at a time with one transition per measurement.
 - t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - t_{PZL} and t_{PZH} are the same as t_{en} .
 - t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 1. Load Circuit and Voltage Waveforms

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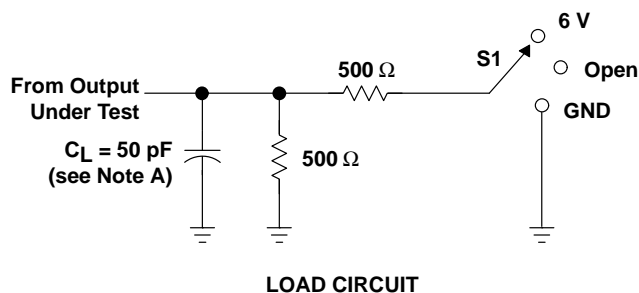
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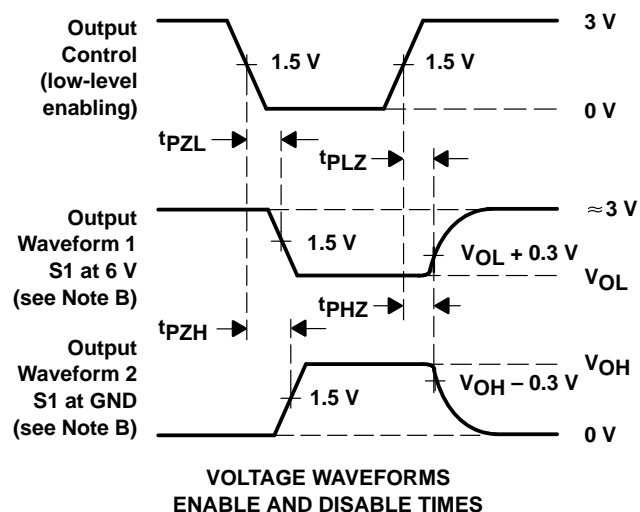
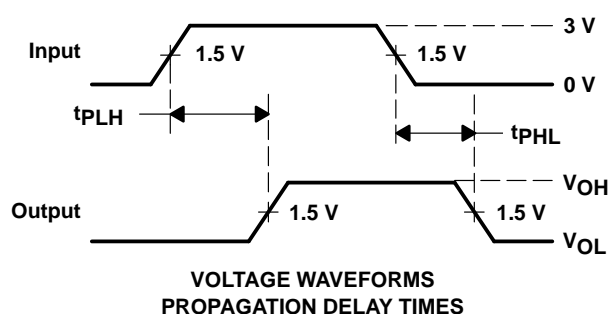
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PARAMETER MEASUREMENT INFORMATION

$V_{CCA} = 2.7 \text{ V AND } 3.3 \text{ V} \pm 0.3 \text{ V}$



TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



- 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.
 - E. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - F. t_{PZL} and t_{PZH} are the same as t_{en} .
 - G. t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 2. Load Circuit and Voltage Waveforms

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