

SN74LVC4245

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

SCAS375C – MARCH 1994 – REVISED JANUARY 1997

- **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**

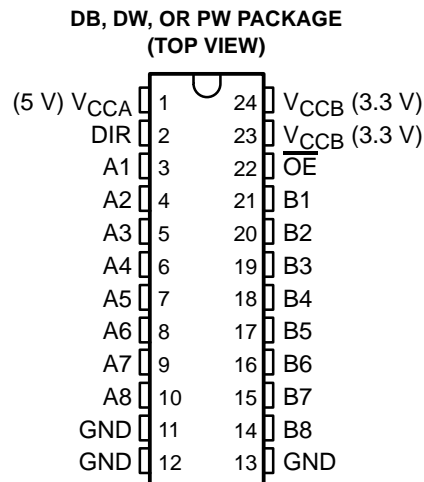
description

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 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 on 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.

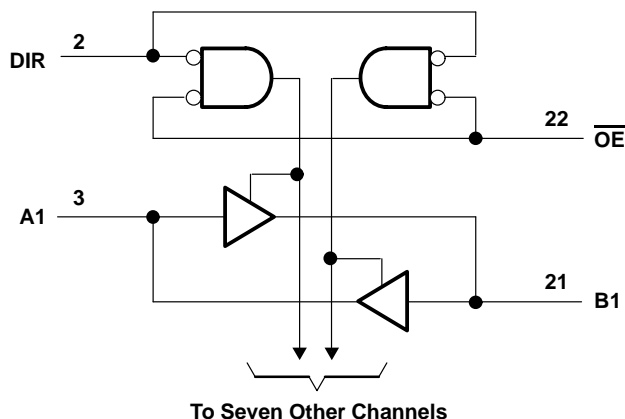
The SN74LVC4245 is characterized for operation from -40°C to 85°C .



FUNCTION TABLE

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

logic diagram (positive logic)



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recommended operating conditions for V_{CCA} at 5 V (see Note 4)

		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 4: 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 4)

			MIN	MAX	UNIT
V_{CCB}	Supply voltage		2.7	3.6	V
V_{IH}	High-level input voltage	$V_{CCB} = 2.7\text{ V to }3.6\text{ V}$	2		V
V_{IL}	Low-level input voltage	$V_{CCB} = 2.7\text{ V to }3.6\text{ V}$		0.8	V
V_I	Input voltage		0	V_{CCB}	V
V_O	Output voltage		0	V_{CCB}	V
I_{OH}	High-level output current	$V_{CCB} = 2.7\text{ V}$		-12	mA
		$V_{CCB} = 3\text{ V}$		-24	
I_{OL}	Low-level output current	$V_{CCB} = 2.7\text{ V}$		12	mA
		$V_{CCB} = 3\text{ V}$		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 4: 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 $V_{CCA} = 5\text{ V}$ (unless otherwise noted) (see Note 5)

PARAMETER		TEST CONDITIONS	V_{CCA}	MIN	TYP†	MAX	UNIT
V_{OH}		$I_{OH} = -100\ \mu\text{A}$	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}		$I_{OL} = 100\ \mu\text{A}$	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		μA	
I_{OZ}^\ddagger	A or B ports	$V_O = V_{CCA}$ or GND	5.5 V			μA	
I_{CC}		$V_I = V_{CCA}$ or GND, $I_O = 0$	5.5 V			μA	
ΔI_{CC}^\S		One input at 3.4 V, Other inputs at V_{CCA} or GND				μA	
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	

† All 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 0 V or the corresponding V_{CC} .

NOTE 5: $V_{CCB} = 2.7\text{ V}$ to 3.6 V

electrical characteristics over recommended operating free-air temperature range for $V_{CCB} = 3.3\text{ V}$ (unless otherwise noted) (see Note 6)

PARAMETER		TEST CONDITIONS	V_{CCB}	MIN	TYP†	MAX	UNIT
V_{OH}		$I_{OH} = -100\ \mu\text{A}$	2.7 V to 3.6 V	$V_{CC} - 0.2$		V	
			2.7 V	2.2			
		$I_{OH} = -12\ \text{mA}$	3 V	2.4			
			3 V	2			
V_{OL}		$I_{OL} = 100\ \mu\text{A}$	2.7 V to 3.6 V	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		μA	
I_{OZ}^\ddagger		$V_O = V_{CCB}$ or GND	3.6 V			μA	
I_{CC}		$V_I = V_{CCB}$ or GND, $I_O = 0$	3.6 V			μA	
ΔI_{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			μA	
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	

† All 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 0 V or the corresponding V_{CC} .

NOTE 6: $V_{CCA} = 5\text{ V} \pm 0.5\text{ V}$

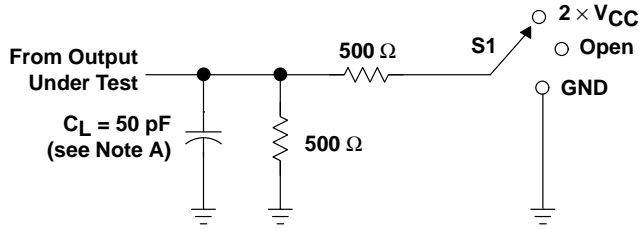
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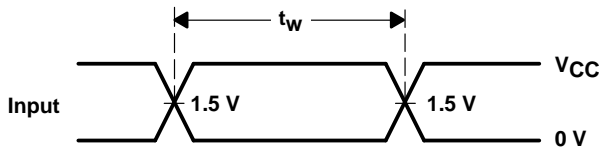
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PARAMETER MEASUREMENT INFORMATION FOR THE A PORT

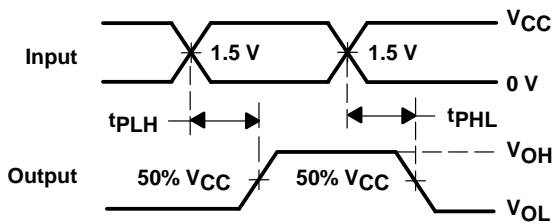


LOAD CIRCUIT

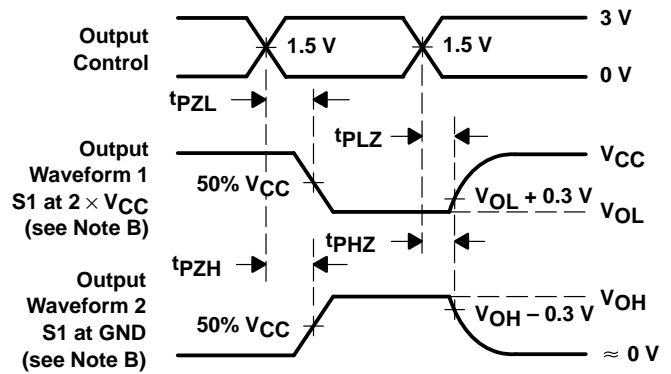
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	$2 \times V_{CC}$
t_{PHZ}/t_{PZH}	GND



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
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.

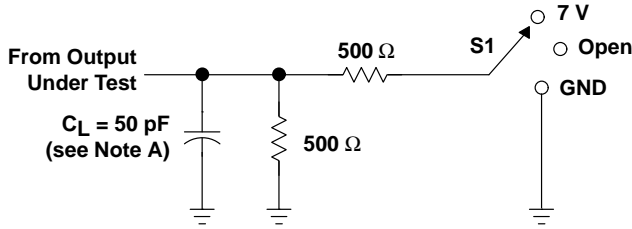
Figure 1. Load Circuit and Voltage Waveforms

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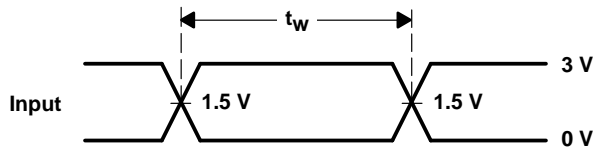
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PARAMETER MEASUREMENT INFORMATION FOR THE B PORT

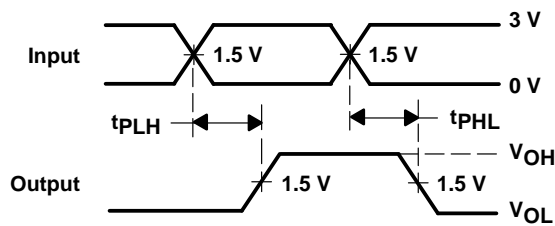


LOAD CIRCUIT

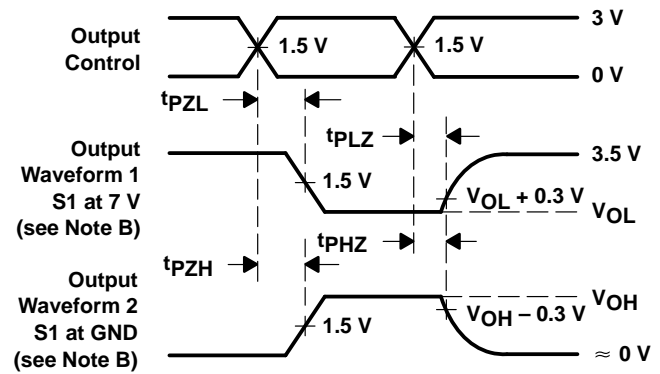
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	GND



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

- NOTES: E. C_L includes probe and jig capacitance.
 F. 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.
 G. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10$ MHz, $Z_O = 50 \Omega$, $t_r \leq 2.5$ ns, $t_f \leq 2.5$ ns.
 H. The outputs are measured one at a time with one transition per measurement.

Figure 2. Load Circuit and Voltage Waveforms

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