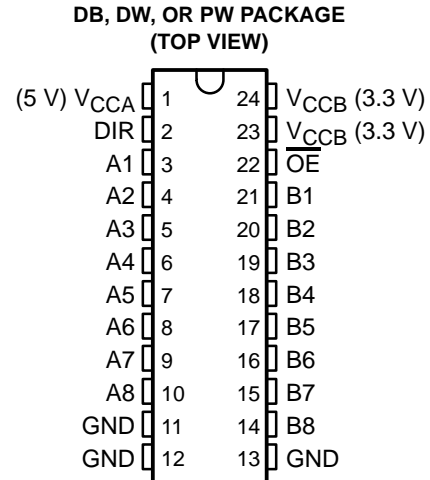


SN74LVC4245A

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

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- Bidirectional Voltage Translator
- 5.5 V on A Port and 2.7 V to 3.6 V on B Port
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)



description/ordering information

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 SN74LVC4245A 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 SN74LVC4245A 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 data paths for pins 2–11 and 14–23 of the SN74LVC4245A to align with the conventional '245 pinout.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SOIC – DW	Tube	SN74LVC4245ADW	LVC4245A
		Tape and reel	SN74LVC4245ADWR	
	SSOP – DB	Tape and reel	SN74LVC4245ADBR	LJ245A
	TSSOP – PW	Tape and reel	SN74LVC4245APWR	LJ245A

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

FUNCTION TABLE

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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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

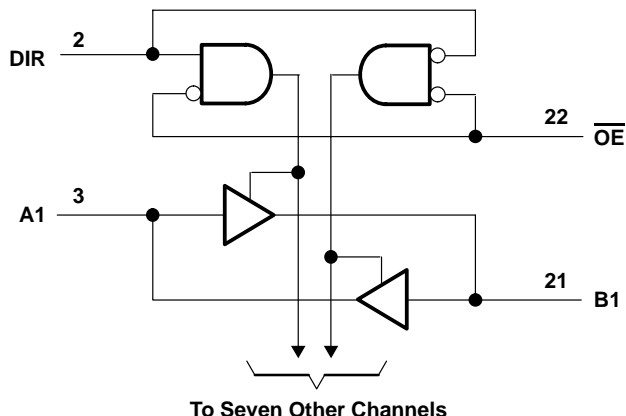
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logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range for $V_{CCA} = 4.5\text{ V to }5.5\text{ V}$ (unless otherwise noted)[†]

Supply voltage range, V_{CCA}	-0.5 V to 6.5 V
Input voltage range, V_I : A port (see Note 1)	-0.5 V to $V_{CCA} + 0.5\text{ V}$
Control inputs	-0.5 V to 6 V
Output voltage range, V_O : A port (see Note 1)	-0.5 V to $V_{CCA} + 0.5\text{ V}$
Input clamp current, I_{IK} ($V_I < 0$)	-50 mA
Output clamp current, I_{OK} ($V_O < 0$)	-50 mA
Continuous output current, I_O	$\pm 50\text{ mA}$
Continuous current through each V_{CCA} or GND	$\pm 100\text{ mA}$
Package thermal impedance, θ_{JA} (see Note 2): DB package	63°C/W
DW package	46°C/W
PW package	88°C/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 package thermal impedance is calculated in accordance with JESD 51-7.



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

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absolute maximum ratings over operating free-air temperature range for $V_{CCB} = 2.7\text{ V to }3.6\text{ V}$ (unless otherwise noted)[†]

Supply voltage range, V_{CCB}	-0.5 V to 4.6 V
Input voltage range, V_I : B port (see Note 3)	-0.5 V to $V_{CCB} + 0.5\text{ V}$
Output voltage range, V_O : B port (see Note 3)	-0.5 V to $V_{CCB} + 0.5\text{ V}$
Input clamp current, I_{IK} ($V_I < 0$)	-50 mA
Output clamp current, I_{OK} ($V_O < 0$)	-50 mA
Continuous output current, I_O	$\pm 50\text{ mA}$
Continuous current through V_{CCB} or GND	$\pm 100\text{ mA}$
Package thermal impedance, θ_{JA} (see Note 2): DB package	63°C/W
DW package	46°C/W
PW package	88°C/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: 2. The package thermal impedance is calculated in accordance with JESD 51-7.
3. This value is limited to 4.6 V maximum.

recommended operating conditions for $V_{CCA} = 4.5\text{ V to }5.5\text{ V}$ (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
T_A Operating free-air temperature	-40	85	°C

NOTE 4: All unused inputs of the device must be held at the associated V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

recommended operating conditions for $V_{CCB} = 2.7\text{ V to }3.6\text{ V}$ (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	
T_A Operating free-air temperature	-40	85	°C

NOTE 4: All unused inputs of the device must be held at the associated V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



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electrical characteristics over recommended operating free-air temperature range for $V_{CCA} = 4.5\text{ V to }5.5\text{ V}$ (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	± 1		μA	
I_{OZ}^\ddagger	A port	$V_O = V_{CCA}$ or GND	5.5 V	± 5		μA	
I_{CCA}		$V_I = V_{CCA}$ or GND, $I_O = 0$	5.5 V	80		μA	
ΔI_{CCA}^\S		One input at 3.4 V, Other inputs at V_{CCA} or GND	5.5 V	1.5		mA	
C_i	Control inputs	$V_I = V_{CCA}$ or GND	Open	5		pF	
C_{io}	A port	$V_O = V_{CCA}$ or GND	5 V	11		pF	

† All typical values are measured at $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$.

‡ 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 associated V_{CC} .

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

electrical characteristics over recommended operating free-air temperature range for $V_{CCB} = 2.7\text{ V to }3.6\text{ V}$ (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_{OZ}^\ddagger	B port	$V_O = V_{CCB}$ or GND	3.6 V	± 5		μA	
I_{CCB}		$V_I = V_{CCB}$ or GND, $I_O = 0$	3.6 V	50		μA	
ΔI_{CCB}^\S		One input at $V_{CCB} - 0.6\text{ V}$, Other inputs at V_{CCB} or GND	2.7 V to 3.6 V	0.5		mA	
C_{io}	B port	$V_O = V_{CCB}$ or GND	3.3 V	11		pF	

‡ 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 associated V_{CC} .

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

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



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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)	$V_{CCA} = 5\text{ V} \pm 0.5\text{ V}$, $V_{CCB} = 2.7\text{ V TO } 3.6\text{ V}$		UNIT
			MIN	MAX	
t_{PHL}	A	B	1	6.3	ns
t_{PLH}			1	6.7	
t_{PHL}	B	A	1	6.1	ns
t_{PLH}			1	5	
t_{PZL}	\overline{OE}	A	1	9	ns
t_{PZH}			1	8.1	
t_{PZL}	\overline{OE}	B	1	8.8	ns
t_{PZH}			1	9.8	
t_{PLZ}	\overline{OE}	A	1	7	ns
t_{PHZ}			1	5.8	
t_{PLZ}	\overline{OE}	B	1	7.7	ns
t_{PHZ}			1	7.8	

operating characteristics, $V_{CCA} = 4.5\text{ V to } 5.5\text{ V}$, $V_{CCB} = 2.7\text{ V to } 3.6\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance per transceiver	$C_L = 0$, $f = 10\text{ MHz}$	39.5	pF
			5	

power-up considerations†

TI level-translation devices offer an opportunity for successful mixed-voltage signal design. A proper power-up sequence always should be followed to avoid excessive supply current, bus contention, oscillations, or other anomalies caused by improperly biased device pins. Take these precautions to guard against such power-up problems.

1. Connect ground before any supply voltage is applied.
2. Next, power up the control side of the device (V_{CCA} for all four of these devices).
3. Tie \overline{OE} to V_{CCA} with a pullup resistor so that it ramps with V_{CCA} .
4. Depending on the direction of the data path, DIR can be high or low. If DIR high is needed (A data to B bus), ramp it with V_{CCA} . Otherwise, keep DIR low.

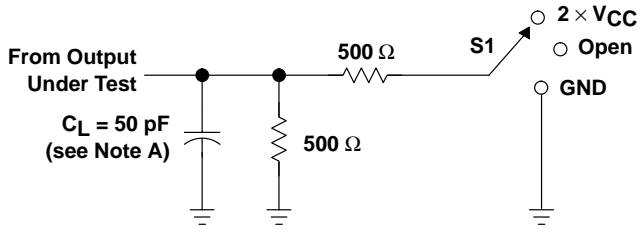
† Refer to the TI application report, *Texas Instruments Voltage-Level-Translation Devices*, literature number SCEA021.



SN74LVC4245A OCTAL BUS TRANSCEIVER AND 3.3-V TO 5-V SHIFTER WITH 3-STATE OUTPUTS

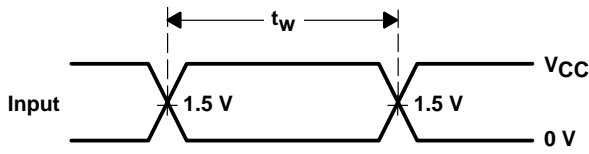
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PARAMETER MEASUREMENT INFORMATION A PORT

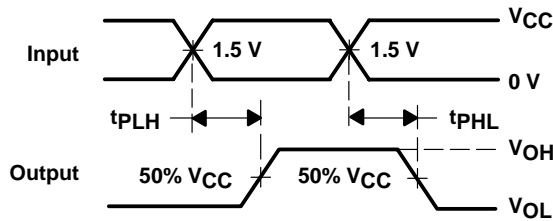


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	$2 \times V_{CC}$
t_{PHZ}/t_{PZH}	GND

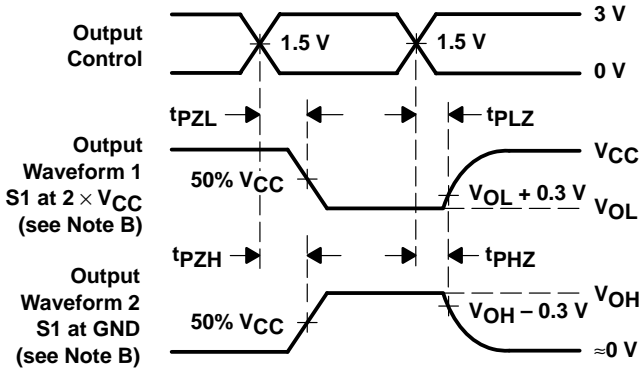
LOAD CIRCUIT



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
NONINVERTING OUTPUTS

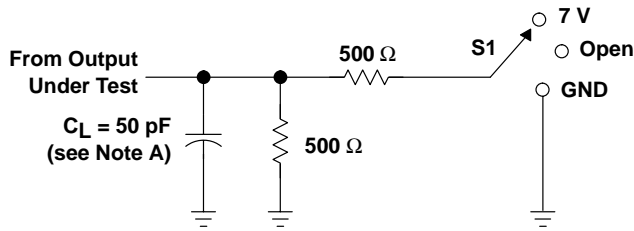


VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

- 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: $PRR \leq 10$ MHz, $Z_O = 50 \Omega$, $t_r \leq 2.5$ ns, $t_f \leq 2.5$ ns.
 - The outputs are measured one at a time with one transition per measurement.
 - All parameters and waveforms are not applicable to all devices.

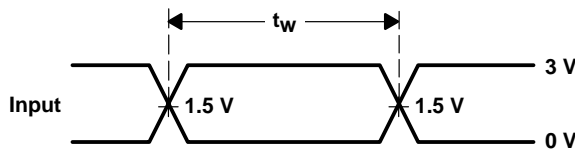
Figure 1. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION
B PORT

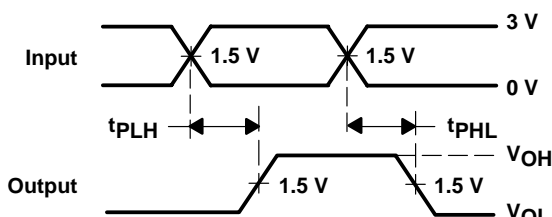


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	GND

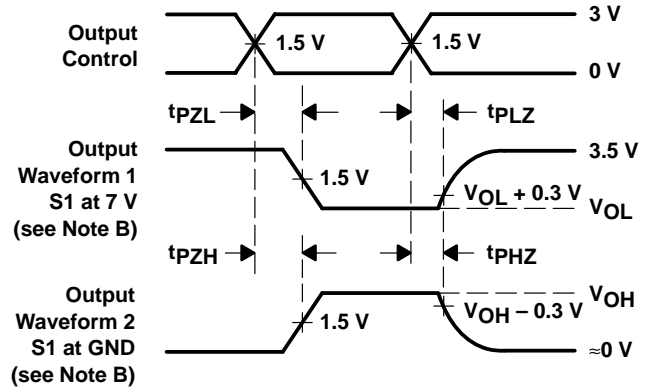
LOAD CIRCUIT



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: $PRR \leq 10$ MHz, $Z_O = 50 \Omega$, $t_r \leq 2.5$ ns, $t_f \leq 2.5$ ns.
 D. The outputs are measured one at a time with one transition per measurement.
 E. All parameters and waveforms are not applicable to all devices.

Figure 2. Load Circuit and Voltage Waveforms

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