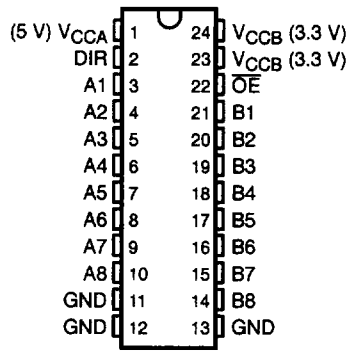
- ***EPIC*™ (Enhanced-Performance Implanted CMOS) Submicron Process**
- **3.3-V to 5-V Bidirectional Level Shifter**
- **Package Options Include Plastic Small-Outline (DW), Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages**

DB, DW, OR PW PACKAGE
(TOP VIEW)



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.

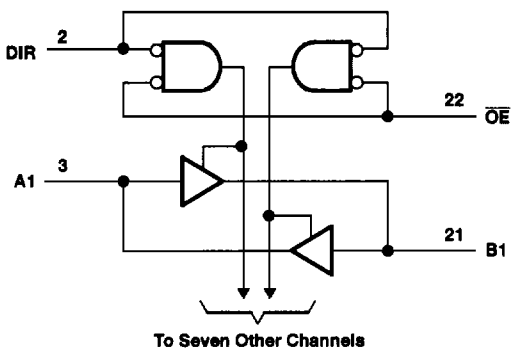
The SN74LVC4245 pinout allows the designer to switch to a normal all-3.3-V or all-5-V 20-pin '245 device without board re-layout. The designer uses the datapaths for pins 2 through 11 and 14 through 23 of the SN74LVC4245 to achieve the conventional '245 layout.

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)



PRODUCT PREVIEW

EPIC is a trademark of Texas Instruments Incorporated.

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

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 $V_O > V_{CCA}$)	±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
Package thermal impedance, θ_{JA} (see Note 2): DB package	104°C/W
DW package	81°C/W
PW package	120°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 EIA/JEDEC Std JESD51.

PRODUCT PREVIEW

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

Supply voltage range, V_{CCB}	–0.5 V to 4.6 V
Input voltage range, V_I (see Note 3): Except I/O ports	–0.5 V to 4.6 V
I/O ports	–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
Package thermal impedance, θ_{JA} (see Note 2): DB package	104°C/W
DW package	81°C/W
PW package	120°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 EIA/JEDEC Std JESD51.
3. This value is limited to 4.6 V maximum.

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 V to 3.6 V	2		V
V_{IL}	Low-level input voltage	V_{CCB} = 2.7 V to 3.6 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 V		–12	mA
		V_{CCB} = 3 V		–24	
I_{OL}	Low-level output current	V_{CCB} = 2.7 V		12	mA
		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 4: Unused inputs must be held high or low to prevent them from floating.

PRODUCT PREVIEW

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

PARAMETER		TEST CONDITIONS		V_{CCA}	MIN	TYP†	MAX	UNIT
V_{OH}		I_{OH} = –100 µA		4.5 V	4.3			V
				5.5 V	5.3			
		I_{OH} = –24 mA		4.5 V	3.7			
				5.5 V	4.7			
V_{OL}		I_{OL} = 100 µA		4.5 V			0.2	V
				5.5 V			0.2	
		I_{OL} = 24 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}‡	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}§		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 V, T_A = 25°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 V to 3.6 V

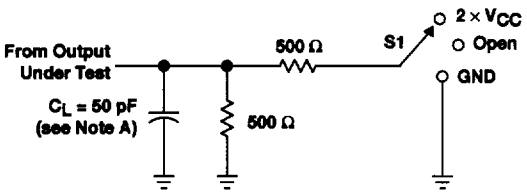
electrical characteristics over recommended operating free-air temperature range for V_{CCB} = 3.3 V (unless otherwise noted) (see Note 6)

PARAMETER		TEST CONDITIONS	V_{CCB}	MIN	TYP†	MAX	UNIT
V_{OH}		I_{OH} = –100 µA	2.7 V to 3.6 V	V_{CC}–0.2			V
		I_{OH} = –12 mA	2.7 V	2.2			
			3 V	2.4			
		I_{OH} = –24 mA	3 V	2			
V_{OL}		I_{OL} = 100 µA	2.7 V to 3.6 V			0.2	V
		I_{OL} = 12 mA	2.7 V			0.4	
		I_{OL} = 24 mA	3 V			0.55	
I_I	Control inputs	V_I = V_{CCB} or GND	3.6 V			5	µA
I_{OZ}‡		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}§		One input at V_{CCB} – 0.6 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 V, T_A = 25°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 V ± 0.5 V

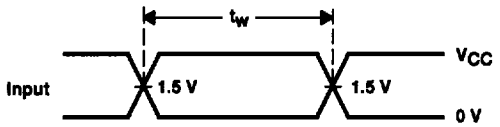
PRODUCT PREVIEW

PARAMETER MEASUREMENT INFORMATION FOR THE A PORT

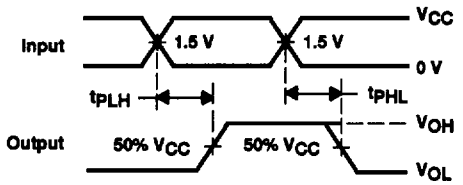


LOAD CIRCUIT

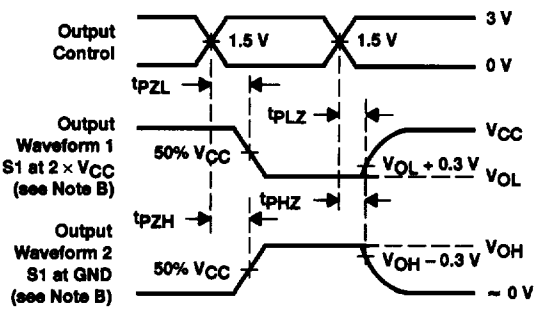
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	2 × V_{CC}
t_{PHZ}/t_{PZH}	GND



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
NONINVERTING OUTPUTS



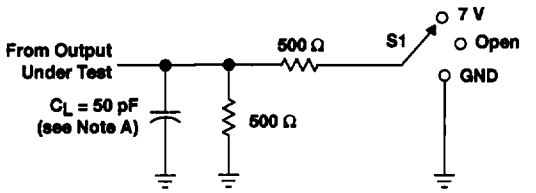
VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

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 ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

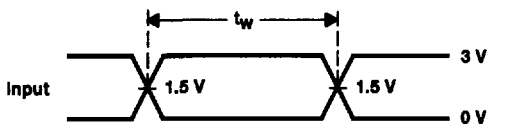
PRODUCT PREVIEW

PARAMETER MEASUREMENT INFORMATION FOR THE B PORT

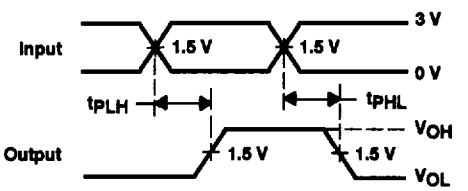


LOAD CIRCUIT

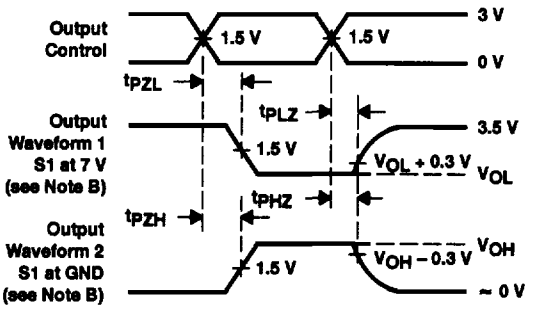
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	GND



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
NONINVERTING OUTPUTS



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

NOTES: 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 ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
D. The outputs are measured one at a time with one transition per measurement.

Figure 2. Load Circuit and Voltage Waveforms

PRODUCT PREVIEW