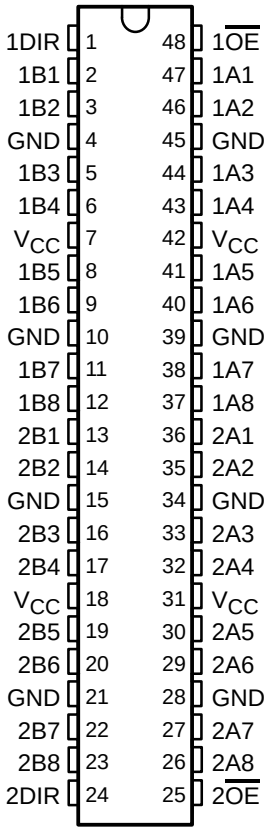
- **Members of the Texas Instruments *Widebus*™ Family**
- **State-of-the-Art Advanced BiCMOS Technology (ABT) Design for 3.3-V Operation and Low-Static Power Dissipation**
- **A-Port Outputs Have Equivalent 22-Ω Series Resistors, So No External Resistors Are Required**
- **High-Impedance State During Power Up and Power Down**
- **Support Mixed-Mode Signal Operation (5-V Input and Output Voltages With 3.3-V V_{CC})**
- **Support Unregulated Battery Operation Down to 2.7 V**
- **Typical V_{OLP} (Output Ground Bounce) < 0.8 V at V_{CC} = 3.3 V, T_A = 25°C**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)**
- **Latch-Up Performance Exceeds 500 mA Per JESD 17**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**
- **Power Off Disables Inputs/Outputs, Permitting Live Insertion**
- **Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise**
- **Flow-Through Architecture Optimizes PCB Layout**
- **Package Options Include Plastic 300-mil Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings**

SN54LVTH162245 . . . WD PACKAGE
SN74LVTH162245 . . . DGG OR DL PACKAGE
(TOP VIEW)



description

The 'LVTH162245 are 16-bit (dual-octal) noninverting 3-state transceivers designed for low-voltage (3.3-V) V_{CC} operation, but with the capability to provide a TTL interface to a 5-V system environment.

description (continued)

These devices can be used as two 8-bit transceivers or one 16-bit transceiver. The devices allow data transmission 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 that the buses are effectively isolated.

The A-port outputs, which are designed to source or sink up to 12 mA, include equivalent 22-Ω series resistors to reduce overshoot and undershoot.

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

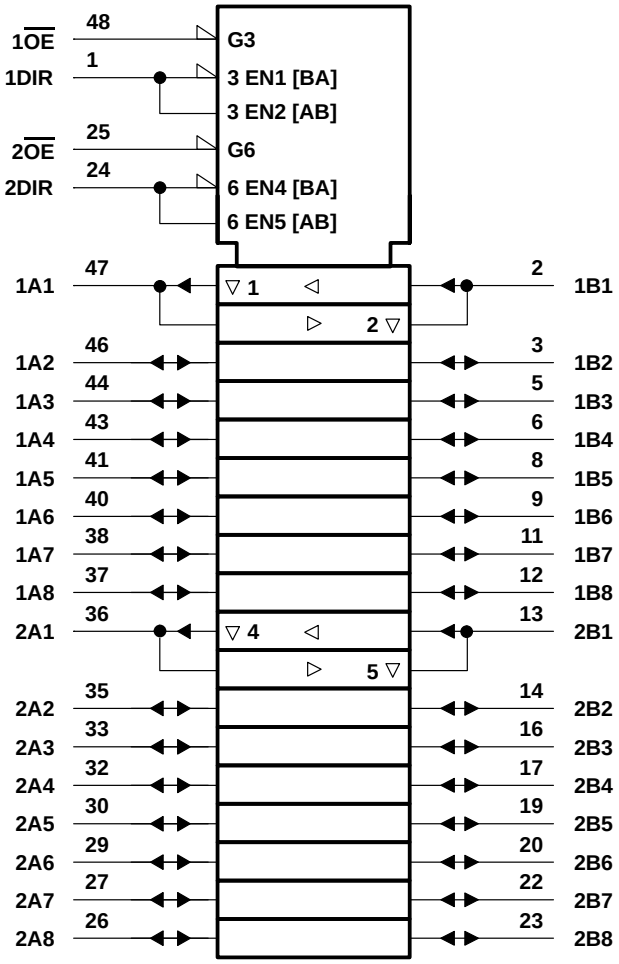
When V_{CC} is between 0 and 1.5 V, the devices are in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.5 V, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN54LVTH162245 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74LVTH162245 is characterized for operation from –40°C to 85°C.

FUNCTION TABLE
(each 8-bit section)

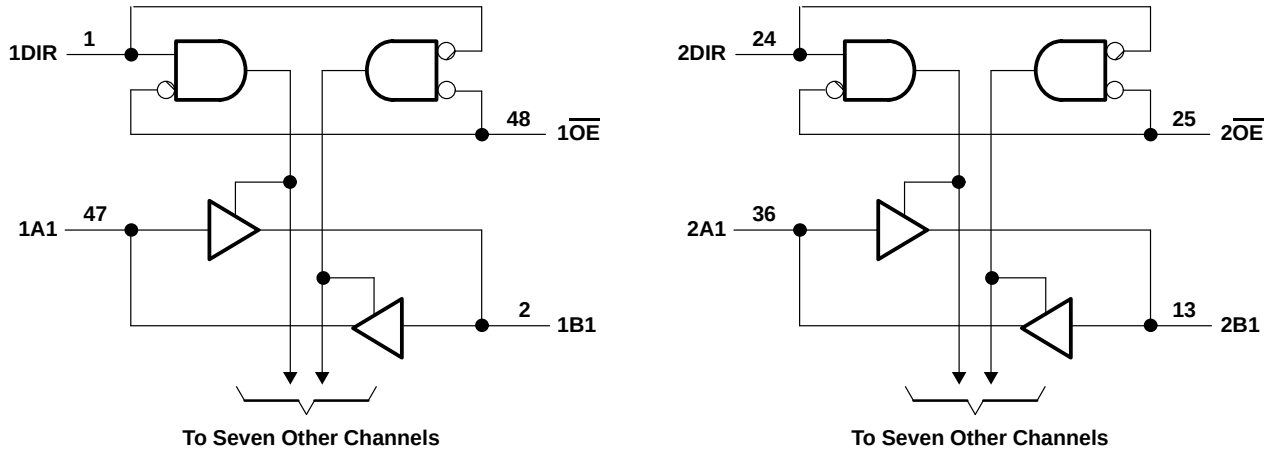
INPUTS		OPERATION
$\overline{OE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

logic symbol†



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

logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC} . . . . . –0.5 V to 4.6 V
Input voltage range, V_I (see Note 1) . . . . . –0.5 V to 7 V
Voltage range applied to any output in the high or power-off state, V_O (see Note 1) . . . . . –0.5 V to 7 V
Current into any output in the low state, I_O: SN54LVTH162245 (B port) . . . . . 96 mA
SN74LVTH162245 (B port) . . . . . 128 mA
A port . . . . . 30 mA
Current into any output in the high state, I_O (see Note 2): SN54LVTH162245 (B port) . . . . . 48 mA
SN74LVTH162245 (B port) . . . . . 64 mA
A port . . . . . 30 mA
Input clamp current, I_{IK} ($V_I < 0$) . . . . . –50 mA
Output clamp current, I_{OK} ($V_O < 0$) . . . . . –50 mA
Package thermal impedance, θ_{JA} (see Note 3): DGG package . . . . . 89°C/W
DL package . . . . . 94°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. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. This current flows only when the output is in the high state and $V_O > V_{CC}$.
3. The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions (see Note 4)

			SN54LVTH162245		SN74LVTH162245		UNIT
			MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		2.7	3.6	2.7	3.6	V
V_{IH}	High-level input voltage		2		2		V
V_{IL}	Low-level input voltage			0.8		0.8	V
V_I	Input voltage			5.5		5.5	V
I_{OH}	High-level output current	A port		–12		–12	mA
		B port		–24		–32	
I_{OL}	Low-level output current	A port		12		12	mA
		B port		48		64	
$\Delta t/\Delta V_{CC}$	Power-up ramp rate		200		200		μs/V
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled		10		10	ns/V
T_A	Operating free-air temperature		–55	125	–40	85	°C

NOTE 4: Unused control inputs must be held high or low to prevent them from floating.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS		SN54LVTH162245			SN74LVTH162245			UNIT
				MIN	TYP†	MAX	MIN	TYP†	MAX	
V_{IK}		V_{CC} = 2.7 V,	I_I = –18 mA			–1.2			–1.2	V
V_{OH}	A port	V_{CC} = 2.7 V to 3.6 V,	I_{OH} = –100 μA	V_{CC}–0.2			V_{CC}–0.2			V
		V_{CC} = 3 V,	I_{OH} = –12 mA	2			2			
	B port	V_{CC} = 2.7 V to 3.6 V,	I_{OH} = –100 μA	V_{CC}–0.2			V_{CC}–0.2			
		V_{CC} = 2.7 V,	I_{OH} = –8 mA	2.4			2.4			
		V_{CC} = 3 V	I_{OH} = –24 mA	2						
			I_{OH} = –32 mA				2			
V_{OL}	A port	V_{CC} = 2.7 V to 3.6 V,	I_{OL} = 100 μA			0.2			0.2	V
		V_{CC} = 3 V,	I_{OL} = 12 mA			0.8			0.8	
	B port	V_{CC} = 2.7 V	I_{OL} = 100 μA			0.2			0.2	
			I_{OL} = 24 mA			0.5			0.5	
		V_{CC} = 3 V	I_{OL} = 16 mA			0.4			0.4	
			I_{OL} = 32 mA			0.5			0.5	
			I_{OL} = 48 mA			0.55				
			I_{OL} = 64 mA						0.55	
I_I	Control pins	V_{CC} = 3.6 V,	V_I = V_{CC} or GND			±1			±1	μA
		V_{CC} = 0 or 3.6 V,	V_I = 5.5 V			10			10	
	A or B ports	V_{CC} = 3.6 V	V_I = 5.5 V			20			20	
			V_I = V_{CC}			5			5	
			V_I = 0			–10			–10	
I_{off}		V_{CC} = 0,	V_I or V_O = 0 to 4.5 V						±100	μA
$I_{I(hold)}$	A or B ports	V_{CC} = 3 V	V_I = 0.8 V	75			75			μA
			V_I = 2 V	–75			–75			
I_{OZPU}‡		V_{CC} = 0 to 1.5 V, V_O = 0.5 V to 3 V, $\overline{OE}$ = Don't care				±100			±100	μA
I_{OZPD}‡		V_{CC} = 1.5 V to 0, V_O = 0.5 V to 3 V, $\overline{OE}$ = Don't care				±100			±100	μA
I_{CC}		V_{CC} = 3.6 V, I_O = 0, V_I = V_{CC} or GND	Outputs high			0.25			0.19	mA
			Outputs low			6			5	
			Outputs disabled			0.25			0.19	
ΔI_{CC}§		V_{CC} = 3 V to 3.6 V, One input at V_{CC} – 0.6 V, Other inputs at V_{CC} or GND				0.3			0.2	mA
C_i		V_I = 3 V or 0			4			4		pF
C_{io}		V_O = 3 V or 0			10			10		pF

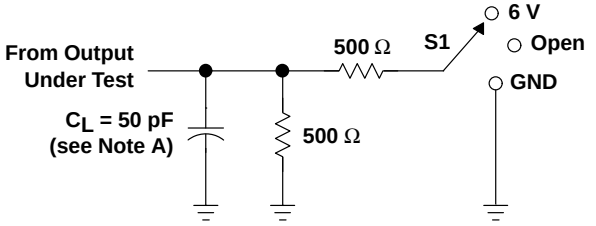
† All typical values are at V_{CC} = 3.3 V, T_A = 25°C.
‡ This parameter is characterized but not production tested.
§ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVTH162245				SN74LVTH162245				UNIT
			V_{CC} = 3.3 V ± 0.3 V		V_{CC} = 2.7 V		V_{CC} = 3.3 V ± 0.3 V			V_{CC} = 2.7 V	
			MIN	MAX	MIN	MAX	MIN	TYP†	MAX	MIN	MAX	
t_{PLH}	A	B	1	3.5		4	1	2.3	3.3		3.7	ns
t_{PHL}			1	3.5		3.9	1	2.2	3.3		3.5	
t_{PLH}	B	A	1	4.3		5.3	1	2.8	4		4.6	ns
t_{PHL}			1	4.2		4.5	1	2.5	3.4		3.6	
t_{PZH}	$\overline{OE}$	B	1	4.8		5.9	1	2.8	4.6		5.4	ns
t_{PZL}			1	4.8		5.5	1	3	4.6		5.2	
t_{PZH}	$\overline{OE}$	A	1	5.5		7.2	1	3.3	5.3		6.3	ns
t_{PZL}			1	5.4		6.4	1	3.3	5.1		5.8	
t_{PHZ}	$\overline{OE}$	B	1.5	5.5		5.8	1.5	3.8	5.2		5.5	ns
t_{PLZ}			1.5	5.5		5.8	1.5	3.5	5.1		5.4	
t_{PHZ}	$\overline{OE}$	A	1.5	5.8		6.5	1.5	4	5.6		5.9	ns
t_{PLZ}			1.2	6.3		6.3	1.5	3.8	5.5		5.5	
$t_{sk(o)}$‡									0.5		0.5	ns

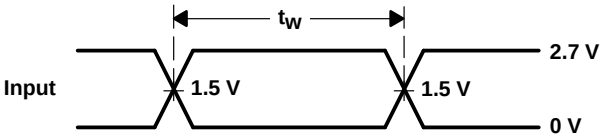
† All typical values are at V_{CC} = 3.3 V, T_A = 25°C.
‡ Skew between any two outputs of the same package switching in the same direction. This parameter is warranted but not production tested.

PARAMETER MEASUREMENT INFORMATION

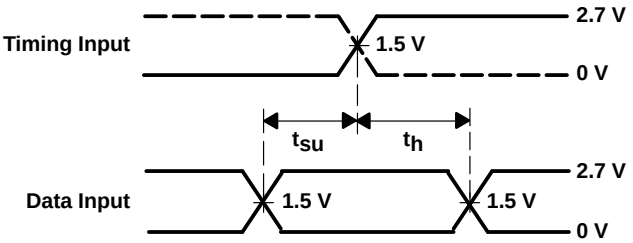


LOAD CIRCUIT

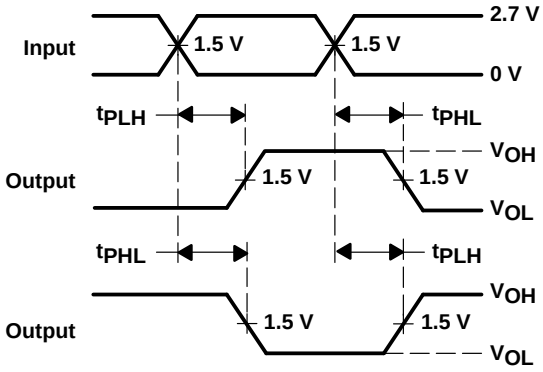
TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



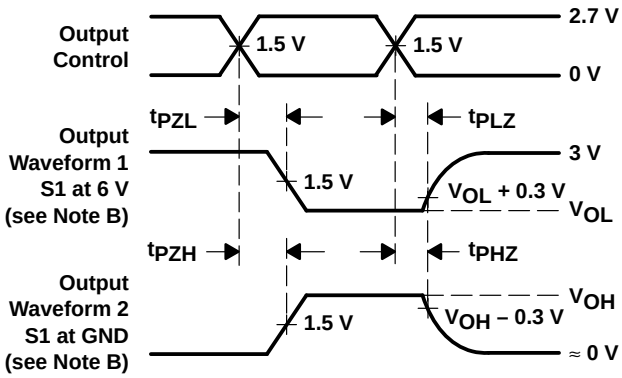
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND 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

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