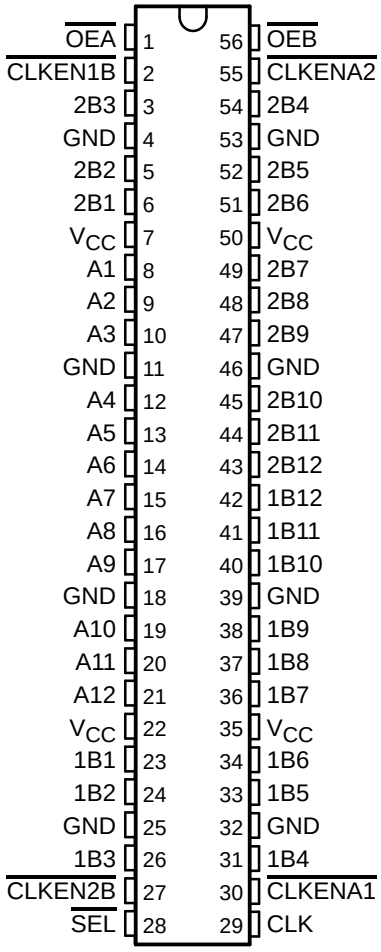
- **Member of the Texas Instruments *Widebus*™ Family**
- ***EPIC*™ (Enhanced-Performance Implanted CMOS) Submicron Process**
- **B-Port Outputs Have Equivalent 26-Ω Series Resistors, So No External Resistors Are Required**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)**
- **Latch-Up Performance Exceeds 250 mA Per JESD 17**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**
- **Package Options Include Plastic Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages**

DGG OR DL PACKAGE
(TOP VIEW)



description

This 12-bit to 24-bit registered bus exchanger is designed for 2.3-V to 3.6-V V_{CC} operation.

The SN74ALVCH162268 is used for applications where data must be transferred from a narrow high-speed bus to a wide, lower-frequency bus.

The device provides synchronous data exchange between the two ports. Data is stored in the internal registers on the low-to-high transition of the clock (CLK) input when the appropriate clock-enable ($\overline{\text{CLKEN}}$) inputs are low. The select ($\overline{\text{SEL}}$) line is synchronous with CLK and selects 1B or 2B input data for the A outputs.

For data transfer in the A-to-B direction, a two-stage pipeline is provided in the A-to-1B path with a single storage register in the A-to-2B path. Proper control of these inputs allows two sequential 12-bit words to be presented synchronously as a 24-bit word on the B port. Data flow is controlled by the active-low output enables ($\overline{\text{OEA}}$, $\overline{\text{OEB}}$). These control terminals are registered so bus direction changes are synchronous with CLK.

The B outputs, which are designed to sink up to 12 mA, include equivalent 26-Ω resistors to reduce overshoot and undershoot.

To ensure the high-impedance state during power up or power down, a clock pulse should be applied as soon as possible and $\overline{\text{OE}}$ 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. Due to $\overline{\text{OE}}$ being routed through a register, the active state of the outputs cannot be determined prior to the arrival of the first clock pulse.

description (continued)

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

The SN74ALVCH162268 is characterized for operation from –40°C to 85°C.

Function Tables

OUTPUT ENABLE

INPUTS			OUTPUTS	
CLK	$\overline{OEA}$	$\overline{OEB}$	A	1B, 2B
↑	H	H	Z	Z
↑	H	L	Z	Active
↑	L	H	Active	Z
↑	L	L	Active	Active

A-TO-B STORAGE ($\overline{OEB}$ = L)

INPUTS				OUTPUTS	
$\overline{CLKENA1}$	$\overline{CLKENA2}$	CLK	A	1B	2B
H	H	X	X	$1B_0$‡	$2B_0$‡
L	X	↑	L	L†	X
L	X	↑	H	H†	X
X	L	↑	L	X	L
X	L	↑	H	X	H

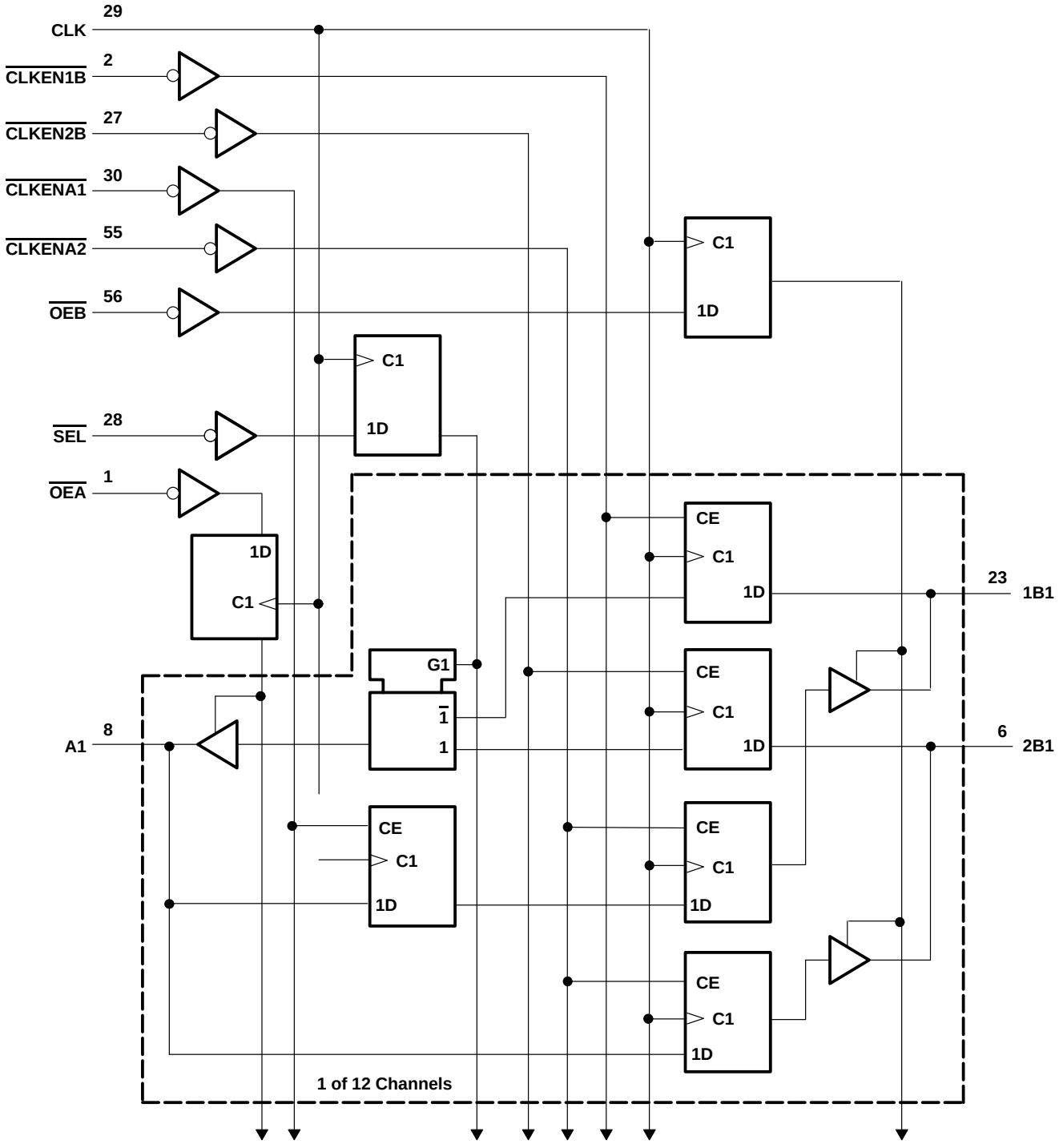
† Two CLK edges are needed to propagate data.
‡ Output level before the indicated steady-state input conditions were established

B-TO-A STORAGE ($\overline{OEA}$ = L)

INPUTS						OUTPUT A
$\overline{CLKEN1B}$	$\overline{CLKEN2B}$	CLK	$\overline{SEL}$	1B	2B	
H	X	X	H	X	X	A_0‡
X	H	X	L	X	X	A_0‡
L	X	↑	H	L	X	L
L	X	↑	H	H	X	H
X	L	↑	L	X	L	L
X	L	↑	L	X	H	H

‡ Output level before the indicated steady-state input conditions were established

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: Except I/O ports (see Note 1) . . . . . –0.5 V to 4.6 V
I/O ports (see Notes 1 and 2) . . . . . –0.5 V to V_{CC} + 0.5 V
Output voltage range, V_O (see Notes 1 and 2) . . . . . –0.5 V to V_{CC} + 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_{CC}) . . . . . ±50 mA
Continuous output current, I_O (V_O = 0 to V_{CC}) . . . . . ±50 mA
Continuous current through each V_{CC} or GND . . . . . ±100 mA
Package thermal impedance, θ_{JA} (see Note 3): DGG package . . . . . 81°C/W
DL package . . . . . 74°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 value is limited to 4.6 V maximum.
3. The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions (see Note 4)

				MIN	MAX	UNIT
V_{CC}	Supply voltage			2.3	3.6	V
V_{IH}	High-level input voltage		V_{CC} = 2.3 V to 2.7 V	1.7		V
			V_{CC} = 2.7 V to 3.6 V	2		
V_{IL}	Low-level input voltage		V_{CC} = 2.3 V to 2.7 V		0.7	V
			V_{CC} = 2.7 V to 3.6 V		0.8	
V_I	Input voltage			0	V_{CC}	V
V_O	Output voltage			0	V_{CC}	V
I_{OH}	High-level output current	A port	V_{CC} = 2.3 V		–12	mA
			V_{CC} = 2.7 V		–12	
			V_{CC} = 3 V		–24	
		B port	V_{CC} = 2.3 V		–6	
			V_{CC} = 2.7 V		–8	
			V_{CC} = 3 V		–12	
I_{OL}	Low-level output current	A port	V_{CC} = 2.3 V		12	mA
			V_{CC} = 2.7 V		12	
			V_{CC} = 3 V		24	
		B port	V_{CC} = 2.3 V		6	
			V_{CC} = 2.7 V		8	
			V_{CC} = 3 V		12	
$\Delta t/\Delta v$	Input transition rise or fall rate			0	10	ns/V
T_A	Operating free-air temperature			–40	85	°C

NOTE 4: Unused 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		V_{CC}	MIN	TYP†	MAX	UNIT
V_{OH}	A port	I_{OH} = –100 μA		2.3 V to 3.6 V			V_{CC}–0.2	V
		I_{OH} = –6 mA,	V_{IH} = 1.7 V	2.3 V	2			
		I_{OH} = –12 mA	V_{IH} = 1.7 V	2.3 V	1.7			
			V_{IH} = 2 V	2.7 V	2.2			
				3 V	2.4			
		I_{OH} = –24 mA,	V_{IH} = 2 V	3 V	2			
	B port	I_{OH} = –100 μA		2.3 V to 3.6 V	V_{CC}–0.2			
		I_{OH} = –4 mA,	V_{IH} = 1.7 V	2.3 V	1.9			
		I_{OH} = –6 mA	V_{IH} = 1.7 V	2.3 V	1.7			
			V_{IH} = 2 V	3 V	2.4			
		I_{OH} = –8 mA,	V_{IH} = 2 V	2.7 V	2			
		I_{OH} = –12 mA,	V_{IH} = 2 V	3 V	2			
V_{OL}	A port	I_{OL} = 100 μA		2.3 V to 3.6 V			0.2	V
		I_{OL} = 6 mA,	V_{IL} = 0.7 V	2.3 V			0.4	
		I_{OL} = 12 mA	V_{IL} = 0.7 V	2.3 V			0.7	
			V_{IL} = 0.8 V	2.7 V			0.4	
		I_{OL} = 24 mA,	V_{IL} = 0.8 V	3 V			0.55	
	B port	I_{OL} = 100 μA		2.3 V to 3.6 V			0.2	
		I_{OL} = 4 mA,	V_{IL} = 0.7 V	2.3 V			0.4	
		I_{OL} = 6 mA	V_{IL} = 0.7 V	2.3 V			0.55	
			V_{IL} = 0.8 V	3 V			0.55	
		I_{OL} = 8 mA,	V_{IL} = 0.8 V	2.7 V			0.6	
		I_{OL} = 12 mA,	V_{IL} = 0.8 V	3 V			0.8	
I_I		V_I = V_{CC} or GND		3.6 V			±5	μA
$I_{I(hold)}$		V_I = 0.7 V		2.3 V	45			μA
		V_I = 1.7 V		2.3 V	–45			
		V_I = 0.8 V		3 V	75			
		V_I = 2 V		3 V	–75			
		V_I = 0 to 3.6 V‡		3.6 V			±500	
I_{OZ}§		V_O = V_{CC} or GND		3.6 V			±10	μA
I_{CC}		V_I = V_{CC} or GND,	I_O = 0	3.6 V			40	μA
ΔI_{CC}		One input at V_{CC} – 0.6 V, Other inputs at V_{CC} or GND		3 V to 3.6 V			750	μA
C_i	Control inputs	V_I = V_{CC} or GND		3.3 V		3.5		pF
C_{io}	A or B ports	V_O = V_{CC} or GND		3.3 V		9		pF

† All typical values are at V_{CC} = 3.3 V, T_A = 25°C.
‡ This is the bus-hold maximum dynamic current required to switch the input from one state to another.
§ For I/O ports, the parameter I_{OZ} includes the input-leakage current.

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

			V_{CC} = 2.5 V ± 0.2 V		V_{CC} = 2.7 V		V_{CC} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		0	120	0	125	0	150	MHz
t_w	Pulse duration, CLK high or low		3.3		3.3		3.3		ns
t_{su}	Setup time	A data before CLK↑	4.5		4		3.4		ns
		B data before CLK↑	0.8		1.2		1		
		$\overline{SEL}$ before CLK↑	1.4		1.6		1.3		
		$\overline{CLKENA1}$ or $\overline{CLKENA2}$ before CLK↑	3.6		3.4		2.8		
		$\overline{CLKENB1}$ or $\overline{CLKENB2}$ before CLK↑	3.2		3		2.5		
		$\overline{OE}$ before CLK↑	4.2		3.9		3.2		
t_h	Hold time	A data after CLK↑	0		0		0.2		ns
		B data after CLK↑	1.3		1.2		1.3		
		$\overline{SEL}$ after CLK↑	1		1		1		
		$\overline{CLKENA1}$ or $\overline{CLKENA2}$ after CLK↑	0.1		0.1		0.4		
		$\overline{CLKENB1}$ or $\overline{CLKENB2}$ after CLK↑	0.1		0		0.5		
		$\overline{OE}$ after CLK↑ after CLK↑	0		0		0.2		

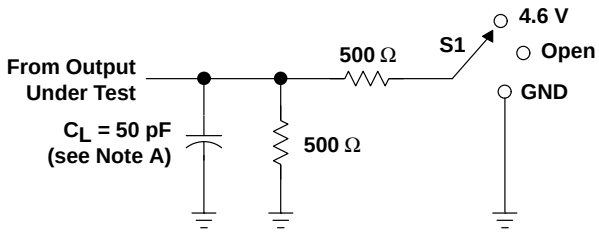
switching characteristics over recommended operating free-air temperature range, C_L = 50 pF (unless otherwise noted) (see Figures 1 and 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 2.5 V ± 0.2 V		V_{CC} = 2.7 V		V_{CC} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{max}			120		125		150		MHz
t_{pd}	CLK	B	2.1	6.7		5.9	1.8	5.4	ns
		A (1B)	2.1	6.4		5.4	1.7	4.8	
		A (2B)	2.1	6.4		5.3	1.8	4.8	
		A ($\overline{SEL}$)	3	7.9		6.5	2.4	5.8	
t_{en}	CLK	B	2.8	7.7		6.8	2.6	6.1	ns
t_{dis}	CLK	B	3.5	7.4		6.1	2.5	5.9	ns
t_{en}	CLK	A	2.1	6.7		5.6	1.8	5.1	ns
t_{dis}	CLK	A	2.7	6.7		5.4	2.1	5	ns

operating characteristics, T_A = 25°C

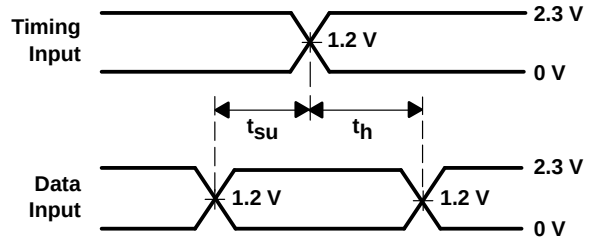
PARAMETER			TEST CONDITIONS	V_{CC} = 2.5 V ± 0.2 V	V_{CC} = 3.3 V ± 0.3 V	UNIT
				TYP	TYP	
C_{pd}	Power dissipation capacitance	Outputs enabled	C_L = 50 pF, f = 10 MHz	87	120	pF
		Outputs disabled		80.5	118	

PARAMETER MEASUREMENT INFORMATION
V_{CC} = 2.5 V ± 0.2 V

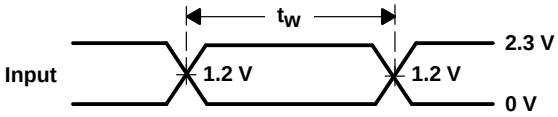


TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	4.6 V
t_{PHZ}/t_{PZH}	GND

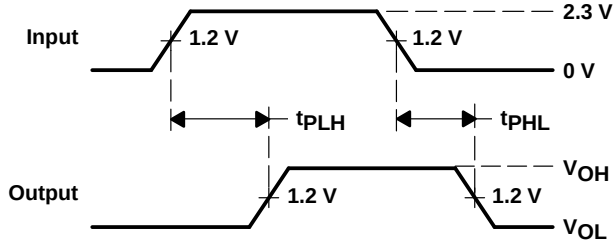
LOAD CIRCUIT



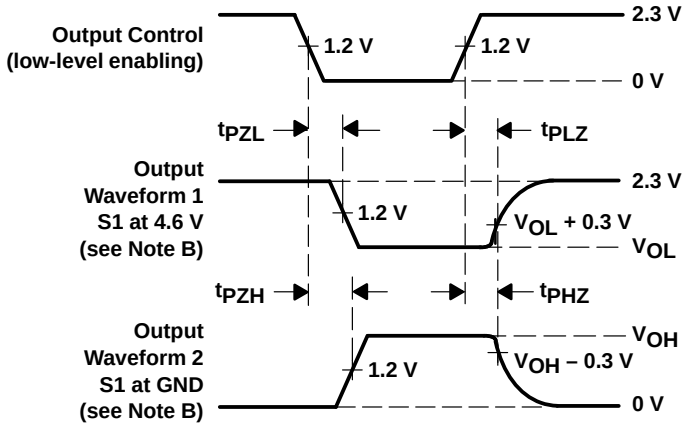
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES

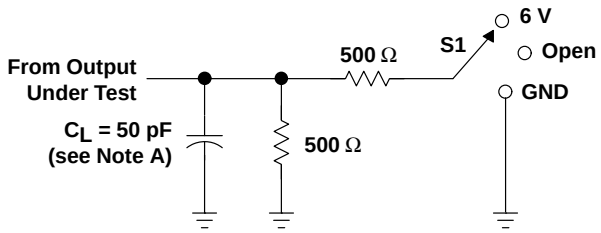


VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

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.
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}.

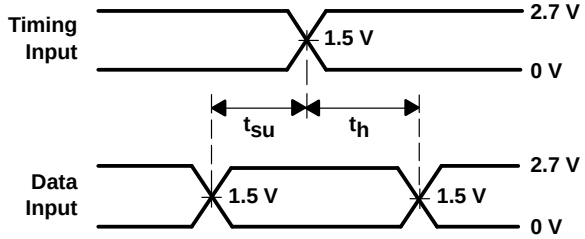
Figure 1. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION
V_{CC} = 2.7 V AND 3.3 V ± 0.3 V

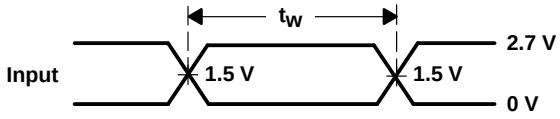


TEST	S1
t_{pd} t_{PLZ}/t_{PZL} t_{PHZ}/t_{PZH}	Open 6 V GND

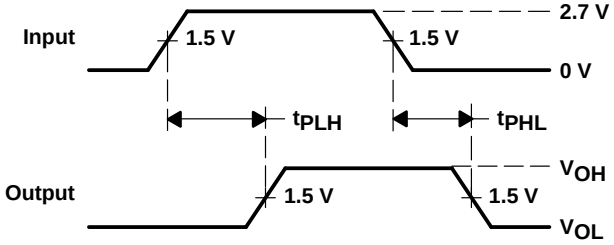
LOAD CIRCUIT



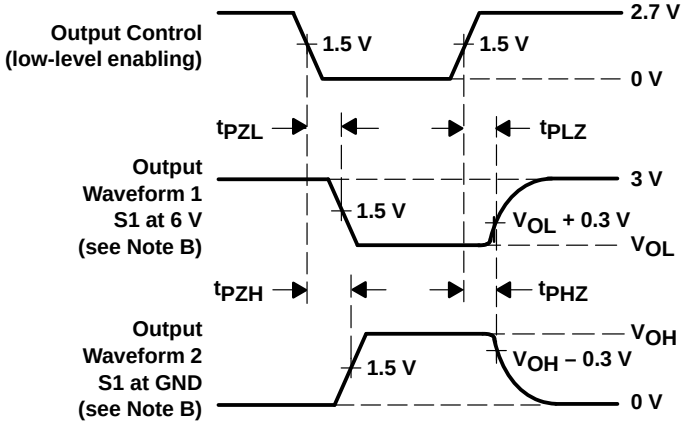
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

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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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