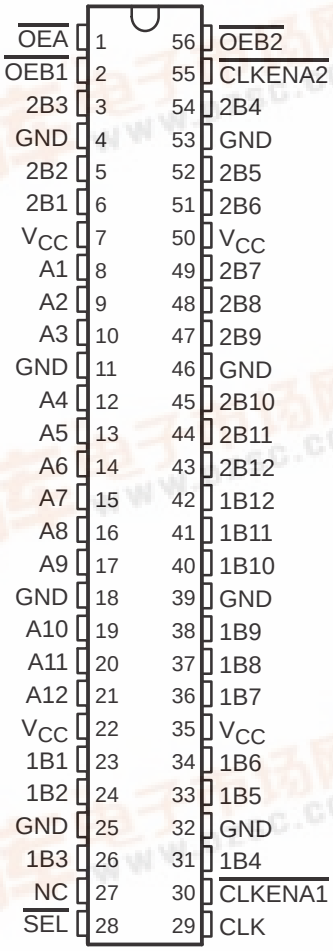
12-BIT TO 24-BIT REGISTERED BUS EXCHANGER WITH 3-STATE OUTPUTS

SCES019I – JULY 1995 – REVISED SEPTEMBER 1999

- **Member of the Texas Instruments *Widebus*™ Family**
- ***EPIC*™ (Enhanced-Performance Implanted CMOS) Submicron Process**
- **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)



NC – No internal connection

description

This 12-bit to 24-bit registered bus exchanger is designed for 1.65-V to 3.6-V V_{CC} operation.

The SN74ALVCH16269 is used in applications in which two separate ports must be multiplexed onto, or demultiplexed from, a single port. The device is particularly suitable as an interface between synchronous DRAMs and high-speed microprocessors.

Data is stored in the internal B-port registers on the low-to-high transition of the clock (CLK) input when the appropriate clock-enable ($\overline{\text{CLKENA}}$) inputs are low. Proper control of these inputs allows two sequential 12-bit words to be presented as a 24-bit word on the B port. For data transfer in the B-to-A direction, a single storage register is provided. The select ($\overline{\text{SEL}}$) line selects 1B or 2B data for the A outputs. The register on the A output permits the fastest possible data transfer, extending the period during which the data is valid on the bus. The control terminals are registered so that all transactions are synchronous with CLK. Data flow is controlled by the active-low output enables ($\overline{\text{OEA}}$, $\overline{\text{OEB1}}$, $\overline{\text{OEB2}}$).

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 before the arrival of the first clock pulse.

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

The SN74ALVCH16269 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
L	H	↑	L	L	$2B_0$†
L	H	↑	H	H	$2B_0$†
L	L	↑	L	L	L
L	L	↑	H	H	H
H	L	↑	L	$1B_0$†	L
H	L	↑	H	$1B_0$†	H
H	H	X	X	$1B_0$†	$2B_0$†

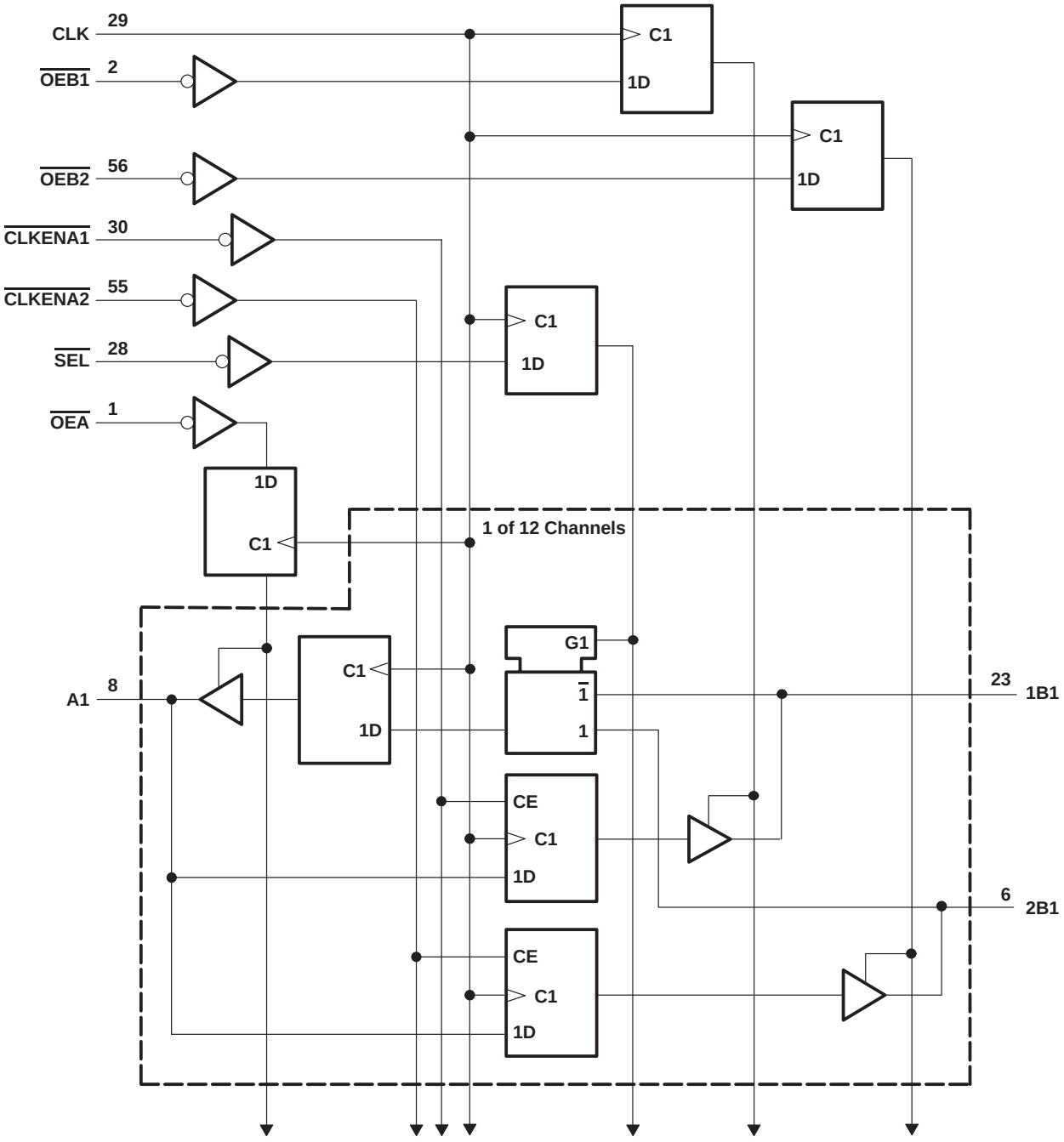
† Output level before the indicated steady-state input conditions were established

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

INPUTS				OUTPUT A
CLK	$\overline{SEL}$	1B	2B	
X	H	X	X	A_0†
X	L	X	X	A_0†
↑	H	L	X	L
↑	H	H	X	H
↑	L	X	L	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) . . . . . –50 mA
Continuous output current, I_O . . . . . ±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
DGV package . . . . . 86°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 negative-voltage and output voltage ratings may be exceeded if the input and output 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		1.65	3.6	V
V_{IH}	High-level input voltage	V_{CC} = 1.65 V to 1.95 V	0.65 × V_{CC}		V
		V_{CC} = 2.3 V to 2.7 V	1.7		
		V_{CC} = 2.7 V to 3.6 V	2		
V_{IL}	Low-level input voltage	V_{CC} = 1.65 V to 1.95 V		0.35 × V_{CC}	V
		V_{CC} = 2.3 V to 2.7 V		0.7	
		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	V_{CC} = 1.65 V		–4	mA
		V_{CC} = 2.3 V		–12	
		V_{CC} = 2.7 V		–12	
		V_{CC} = 3 V		–24	
I_{OL}	Low-level output current	V_{CC} = 1.65 V		4	mA
		V_{CC} = 2.3 V		12	
		V_{CC} = 2.7 V		12	
		V_{CC} = 3 V		24	
$\Delta t/\Delta v$	Input transition rise or fall rate			10	ns/V
T_A	Operating free-air temperature		–40	85	°C

NOTE 4: All unused control inputs of the device must be held at 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.

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

PARAMETER		TEST CONDITIONS		V_{CC}	MIN	TYP†	MAX	UNIT
V_{OH}		I_{OH} = –100 μA		1.65 V to 3.6 V	V_{CC}–0.2			V
		I_{OH} = –4 mA		1.65 V	1.2			
		I_{OH} = –6 mA		2.3 V	2			
		I_{OH} = –12 mA		2.3 V	1.7			
				2.7 V	2.2			
				3 V	2.4			
		I_{OH} = –24 mA		3 V	2			
V_{OL}		I_{OL} = 100 μA		1.65 V to 3.6 V			0.2	V
		I_{OL} = 4 mA		1.65 V			0.45	
		I_{OL} = 6 mA		2.3 V			0.4	
		I_{OL} = 12 mA		2.3 V			0.7	
				2.7 V			0.4	
		I_{OL} = 24 mA		3 V			0.55	
I_I		V_I = V_{CC} or GND		3.6 V			±5	μA
$I_{I(hold)}$		V_I = 0.58 V		1.65 V	25			μA
		V_I = 1.07 V		1.65 V	–25			
		V_I = 0.7 V		2.3 V	45			
		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. It is the minimum overdrive 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 operating free-air temperature range (unless otherwise noted) (see Figures 1 through 3)

			V_{CC} = 1.8 V		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	MIN	MAX	
f_{clock}	Clock frequency			†		135		135		135	MHz
t_w	Pulse duration, CLK high or low		†		3.3		3.3		3.3		ns
t_{su}	Setup time	A data before CLK↑	†		2		2		1.7		ns
		B data before CLK↑	†		2.2		2.1		1.8		
		$\overline{SEL}$ before CLK↑	†		1.6		1.6		1.3		
		$\overline{CLKENA1}$ or $\overline{CLKENA2}$ before CLK↑	†		1		1.2		0.9		
		$\overline{OE}$ before CLK↑	†		1.5		1.6		1.3		
t_h	Hold time	A data after CLK↑	†		0.7		0.6		0.6		ns
		B data after CLK↑	†		0.7		0.6		0.6		
		$\overline{SEL}$ after CLK↑	†		1.1		0.7		0.7		
		$\overline{CLKENA1}$ or $\overline{CLKENA2}$ after CLK↑	†		1		0.8		1.1		
		$\overline{OE}$ after CLK↑	†		0.8		0.8		0.8		

† This information was not available at the time of publication.

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figures 1 through 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 1.8 V		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	MIN	MAX	
f_{max}			†		135		135		135		MHz
t_{pd}	CLK	B		†	1	8.2		7.3	1	6.2	ns
		A		†	1	6.4		5.8	1	5	
t_{en}	CLK	B		†	1	7.9		6.7	1	6.1	ns
		A		†	1	7.6		6.2	1	5.9	
t_{dis}	CLK	B		†	1	8.1		6.9	1	6.1	ns
		A		†	1	7.5		6.8	1	5.6	

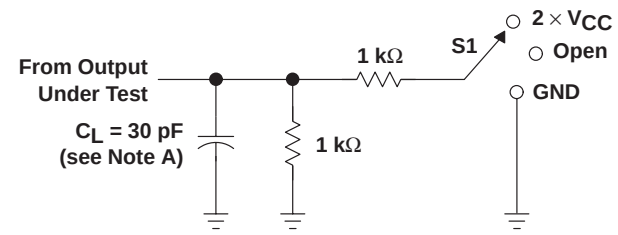
† This information was not available at the time of publication.

operating characteristics, T_A = 25°C

PARAMETER			TEST CONDITIONS	V_{CC} = 1.8 V	V_{CC} = 2.5 V	V_{CC} = 3.3 V	UNIT
				TYP	TYP	TYP	
C_{pd}	Power dissipation capacitance per exchanger	All outputs enabled	C_L = 50 pF, f = 10 MHz	†	87	120	pF
		All outputs disabled		†	80.5	118	

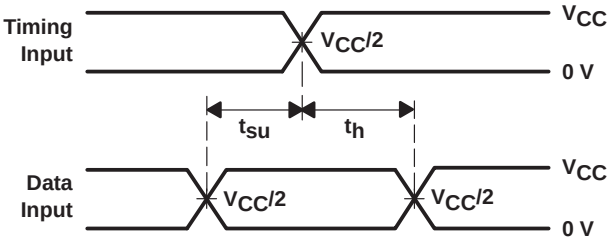
† This information was not available at the time of publication.

PARAMETER MEASUREMENT INFORMATION
V_{CC} = 1.8 V

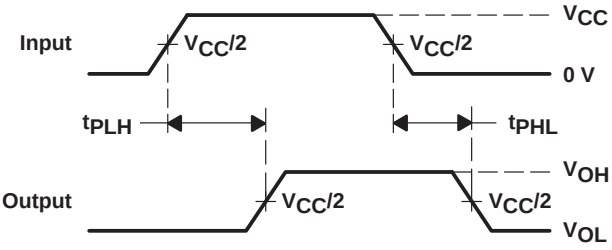


TEST	S1
t_{pd} t_{PLZ}/t_{PZL} t_{PHZ}/t_{PZH}	Open 2 × V_{CC} GND

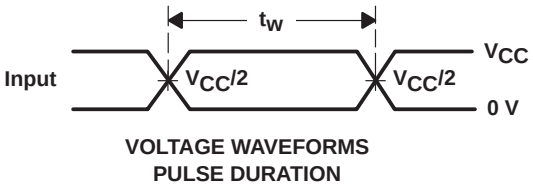
LOAD CIRCUIT



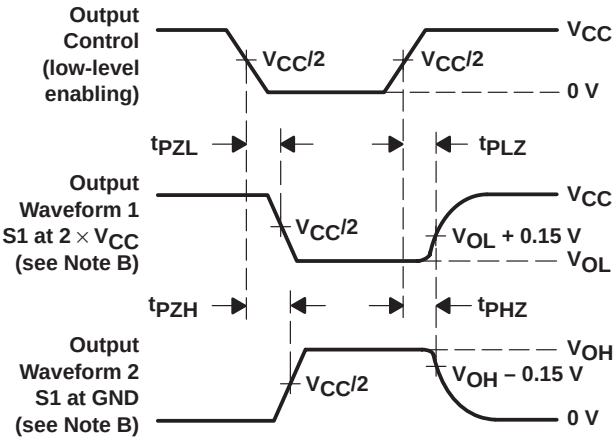
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
PULSE DURATION

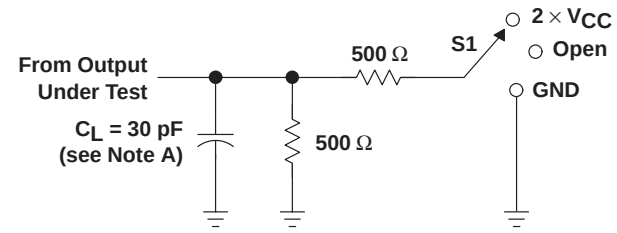


VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

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 ns, t_f ≤ 2 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}.

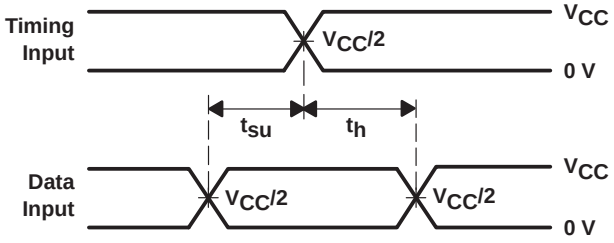
Figure 1. Load Circuit and Voltage Waveforms

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

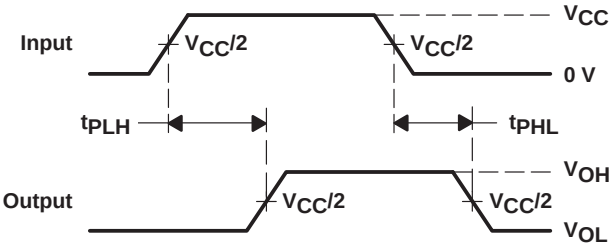


TEST	S1
t_{pd} t_{PLZ}/t_{PZL} t_{PHZ}/t_{PZH}	Open 2 × V_{CC} GND

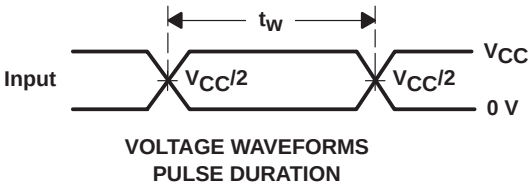
LOAD CIRCUIT



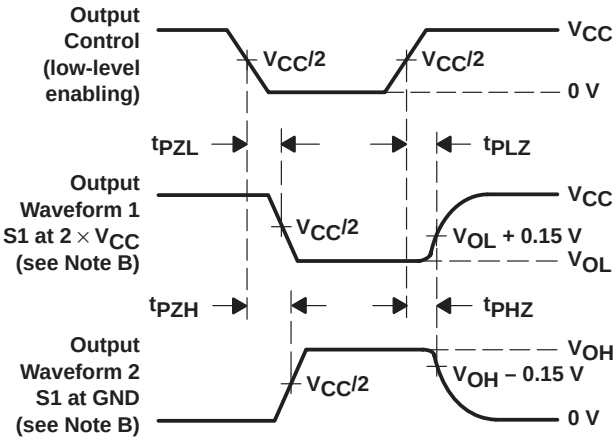
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
PULSE DURATION

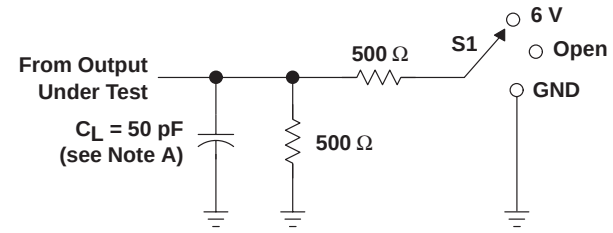


VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

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 ns, t_f ≤ 2 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}.

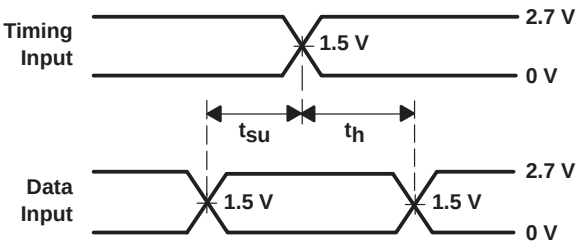
Figure 2. Load Circuit and Voltage Waveforms

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

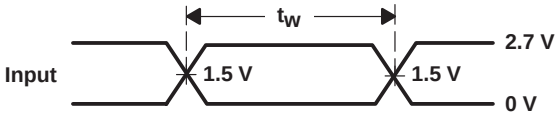


TEST	S1
t_{pd} t_{PLZ}/t_{PZL} t_{PHZ}/t_{PZH}	Open 6 V GND

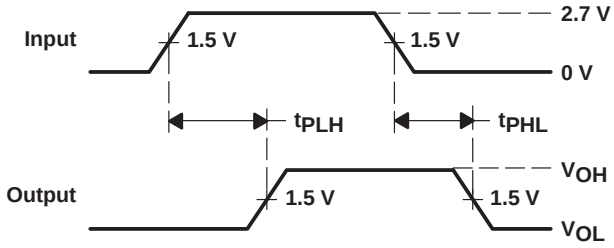
LOAD CIRCUIT



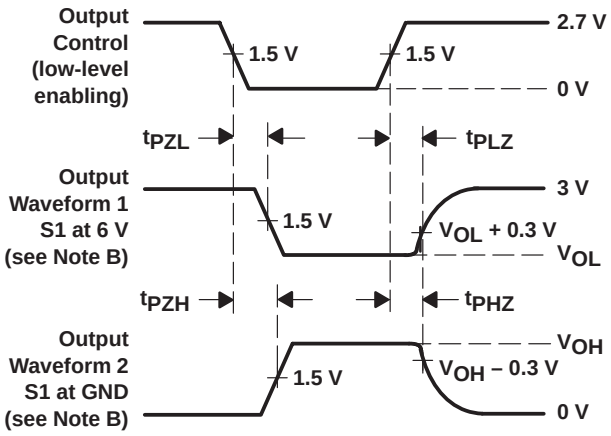
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

NOTES: A. C_L includes probe and jig capacitance.
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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 3. Load Circuit and Voltage Waveforms

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