

SN74ALVC16501 18-BIT UNIVERSAL BUS TRANSCEIVER WITH 3-STATE OUTPUTS

SCAS261A – JANUARY 1993 – REVISED JULY 1995

- **EPIC™ (Enhanced-Performance Implanted CMOS) Submicron Process**
- **Member of the Texas Instruments Widebus™ Family**
- **UBT™ (Universal Bus Transceiver) Combines D-Type Latches and D-Type Flip-Flops for Operation in Transparent, Latched, or Clocked Mode**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)**
- **Latch-Up Performance Exceeds 250 mA Per JEDEC Standard JESD-17**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**
- **Package Options Include Plastic 300-mil Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages**

description

The SN74ALVC16501 18-bit universal bus transceiver is designed for low-voltage (3.3-V) V_{CC} operation; it is tested at 2.5-V, 2.7-V, and 3.3-V V_{CC} .

Data flow in each direction is controlled by output-enable (OEAB and \overline{OEBA}), latch-enable (LEAB and LEBA), and clock (CLKAB and CLKBA) inputs. For A-to-B data flow, the device operates in the transparent mode when LEAB is high. When LEAB is low, the A data is latched if CLKAB is held at a high or low logic level. If LEAB is low, the A-bus data is stored in the latch/flip-flop on the low-to-high transition of CLKAB. When OEAB is high, the outputs are active. When OEAB is low, the outputs are in the high-impedance state.

Data flow for B to A is similar to that of A to B but uses \overline{OEBA} , LEBA, and CLKBA. The output enables are complementary (OEAB is active high and \overline{OEBA} is active low).

The SN74ALVC16501 is available in TI's shrink small-outline (DL) and thin shrink small-outline (DGG) packages, which provide twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The SN74ALVC16501 is characterized for operation from -40°C to 85°C .

DGG OR DL PACKAGE
(TOP VIEW)

OEAB	1	56	GND
LEAB	2	55	CLKAB
A1	3	54	B1
GND	4	53	GND
A2	5	52	B2
A3	6	51	B3
V_{CC}	7	50	V_{CC}
A4	8	49	B4
A5	9	48	B5
A6	10	47	B6
GND	11	46	GND
A7	12	45	B7
A8	13	44	B8
A9	14	43	B9
A10	15	42	B10
A11	16	41	B11
A12	17	40	B12
GND	18	39	GND
A13	19	38	B13
A14	20	37	B14
A15	21	36	B15
V_{CC}	22	35	V_{CC}
A16	23	34	B16
A17	24	33	B17
GND	25	32	GND
A18	26	31	B18
OEBA	27	30	CLKBA
LEBA	28	29	GND

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FUNCTION TABLE†

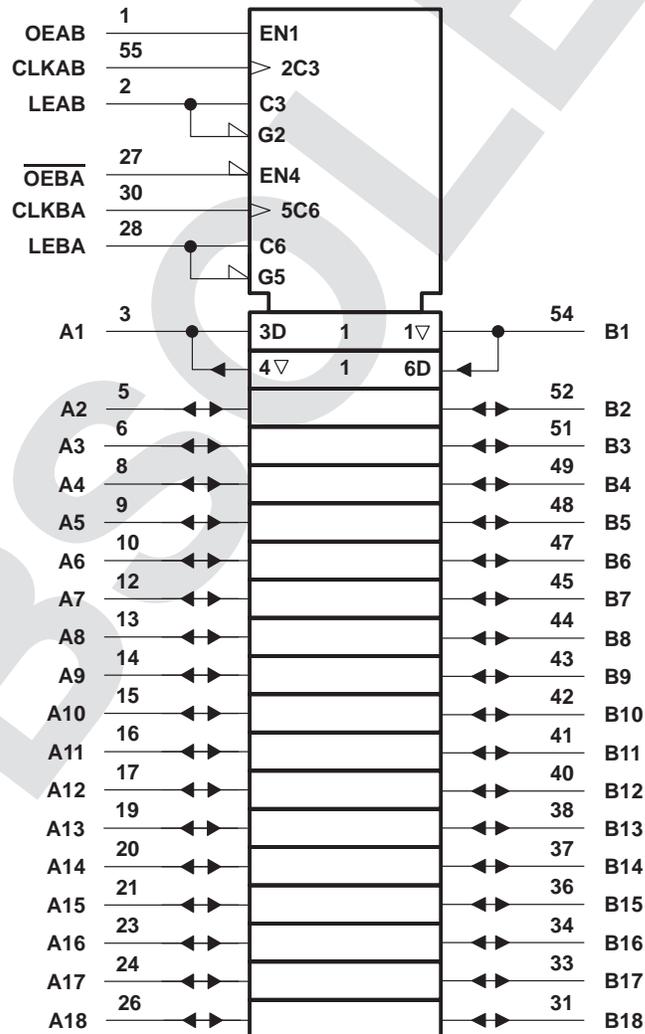
INPUTS				OUTPUT
OEAB	LEAB	CLKAB	A	B
L	X	X	X	Z
H	H	X	L	L
H	H	X	H	H
H	L	↑	L	L
H	L	↑	H	H
H	L	H	X	B ₀ †
H	L	L	X	B ₀ §

† A-to-B data flow is shown: B-to-A flow is similar but uses OEBA, LEBA, and CLKBA.

‡ Output level before the indicated steady-state input conditions were established, provided that CLKAB is high before LEAB goes low

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

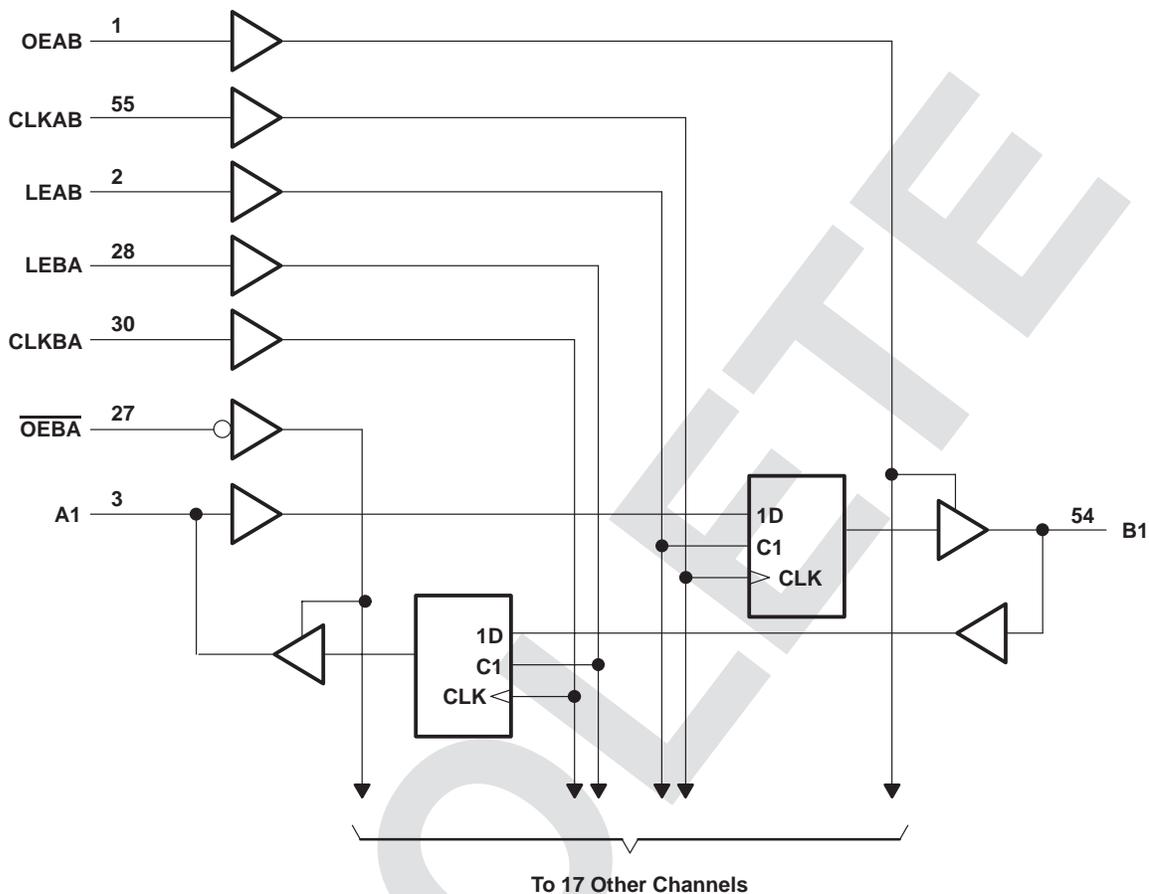
logic symbol†



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

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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
Input voltage range, V_I (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 V_{CC} or GND	± 100 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 3): DGG package	1 W
DL package	1.4 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 maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils. For more information, refer to the *Package Thermal Considerations* application note in the 1994 *ABT Advanced BiCMOS Technology Data Book*, literature number SCBD002B.

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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	V _{CC} = 2.3 V	-12	mA
		V _{CC} = 2.7 V	-12	
		V _{CC} = 3 V	-24	
I _{OL}	Low-level output current	V _{CC} = 2.3 V	12	mA
		V _{CC} = 2.7 V	12	
		V _{CC} = 3 V	24	
Δt/Δv	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.

OBSOLETE

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

PARAMETER	TEST CONDITIONS		V _{CC} †	T _A = -40°C to 85°C			UNIT
				MIN	TYP‡	MAX	
V _{OH}	I _{OH} = -100 μA		MIN to MAX	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			
	V _{IH} = 2 V	3 V	2.4				
I _{OH} = -24 mA	V _{IH} = 2 V	3 V	2				
V _{OL}	I _{OL} = 100 μA		MIN to MAX	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			
I _I	V _I = V _{CC} or GND		3.6 V				μA
I _{hold}	V _I = 0.7 V		2.3 V	45			μA
	V _I = 1.7 V			-45			
	V _I = 0.8 V		3 V	75			
	V _I = 2 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}	V _{CC} = 3 V to 3.6 V, One input at V _{CC} - 0.6 V, Other inputs at V _{CC} or GND			750			μA
C _i	Control inputs	V _I = V _{CC} or GND	3.3 V	4			pF
C _{io}	A or B ports	V _O = V _{CC} or GND	3.3 V	8			pF

† For conditions shown as MIN or MAX, use the appropriate values under recommended operating conditions.

‡ All typical values are at V_{CC} = 3.3 V.

§ 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)

		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	150	0	150	0	150	MHz
t _w	Pulse duration	LE high		3.3		3.3		ns
		CLK high or low		3.3		3.3		
t _{su}	Setup time	Data before CLK↑		2.2		2.1		ns
		Data before LE↓, CLK high		1.9		1.6		
		Data before LE↓, CLK low		1.3		1.1		
t _h	Hold time	Data after CLK↑		0.6		0.6		ns
		Data after LE↓, CLK high or low		1.4		1.7		

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 2.5 V \pm 0.2 V$		$V_{CC} = 2.7 V$		$V_{CC} = 3.3 V \pm 0.3 V$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{max}			150		150		150		ns
t_{pd}	A or B	B or A	1.2	5.4		4.5	1	3.9	ns
	LE	A or B	1.6	6.3		5.3	1.3	4.6	
	CLK	A or B	1.7	6.7		5.6	1.4	4.9	
t_{en}	\overline{OEAB}	B	1.1	6.3		5.3	1	4.6	ns
t_{dis}	\overline{OEAB}	B	2.2	6.4		5.7	1.4	5	ns
t_{en}	\overline{OEBA}	A	1.4	6.8		6	1.1	5	ns
t_{dis}	\overline{OEBA}	A	2	5.5		4.6	1.3	4.2	ns

operating characteristics, $T_A = 25^\circ C$

PARAMETER		TEST CONDITIONS	$V_{CC} = 2.5 V \pm 0.2 V$	$V_{CC} = 3.3 V \pm 0.3 V$	UNIT
			TYP	TYP	
C_{pd}	Power dissipation capacitance	$C_L = 50 pF, f = 10 MHz$	44	54	pF
	Outputs enabled		6	6	
	Outputs disabled				

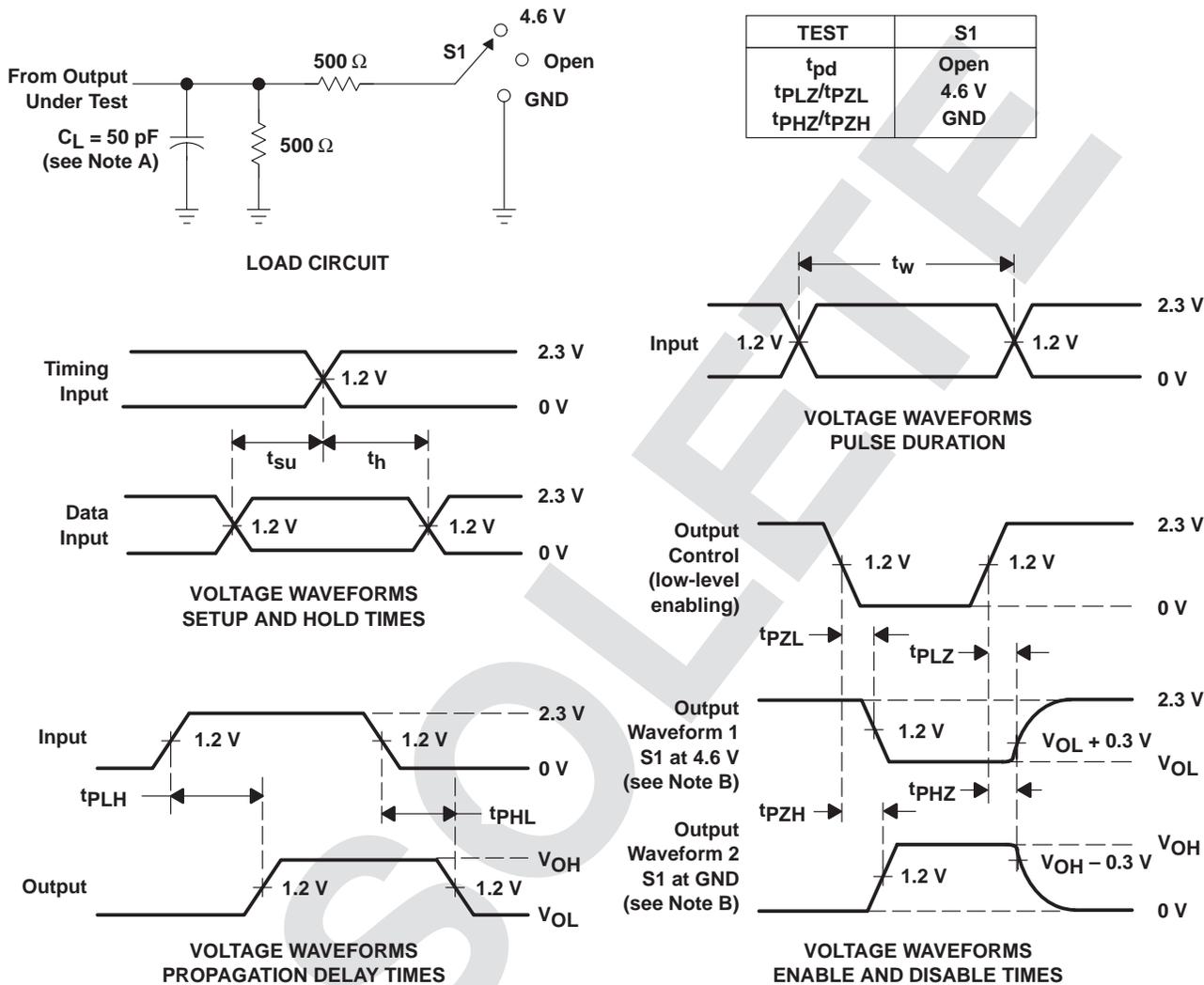
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PARAMETER MEASUREMENT INFORMATION

$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$



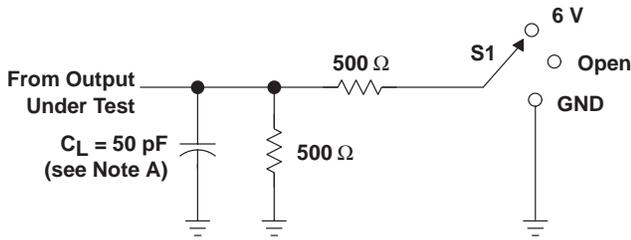
- NOTES:
- A. C_L includes probe and jig capacitance.
 - B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
 - C. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2.5\text{ ns}$, $t_f \leq 2.5\text{ ns}$.
 - 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

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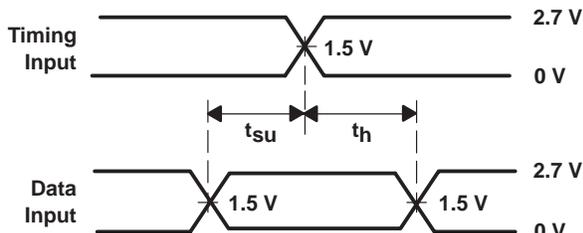
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PARAMETER MEASUREMENT INFORMATION
 $V_{CC} = 2.7\text{ V AND } 3.3\text{ V} \pm 0.3\text{ V}$

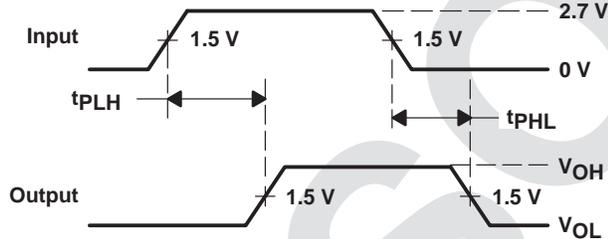


LOAD CIRCUIT

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



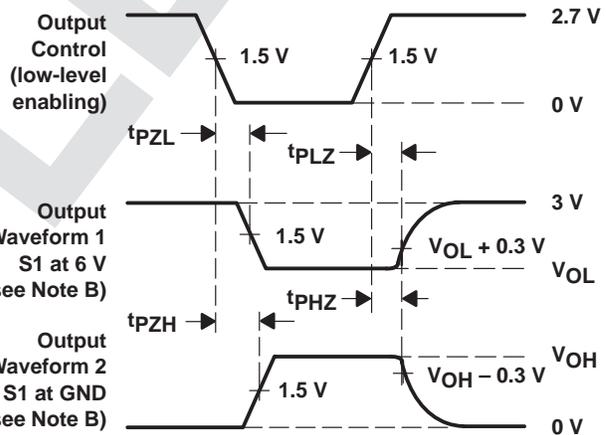
VOLTAGE WAVEFORMS SETUP AND HOLD TIMES



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: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2.5\text{ ns}$, $t_f \leq 2.5\text{ ns}$.
 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

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