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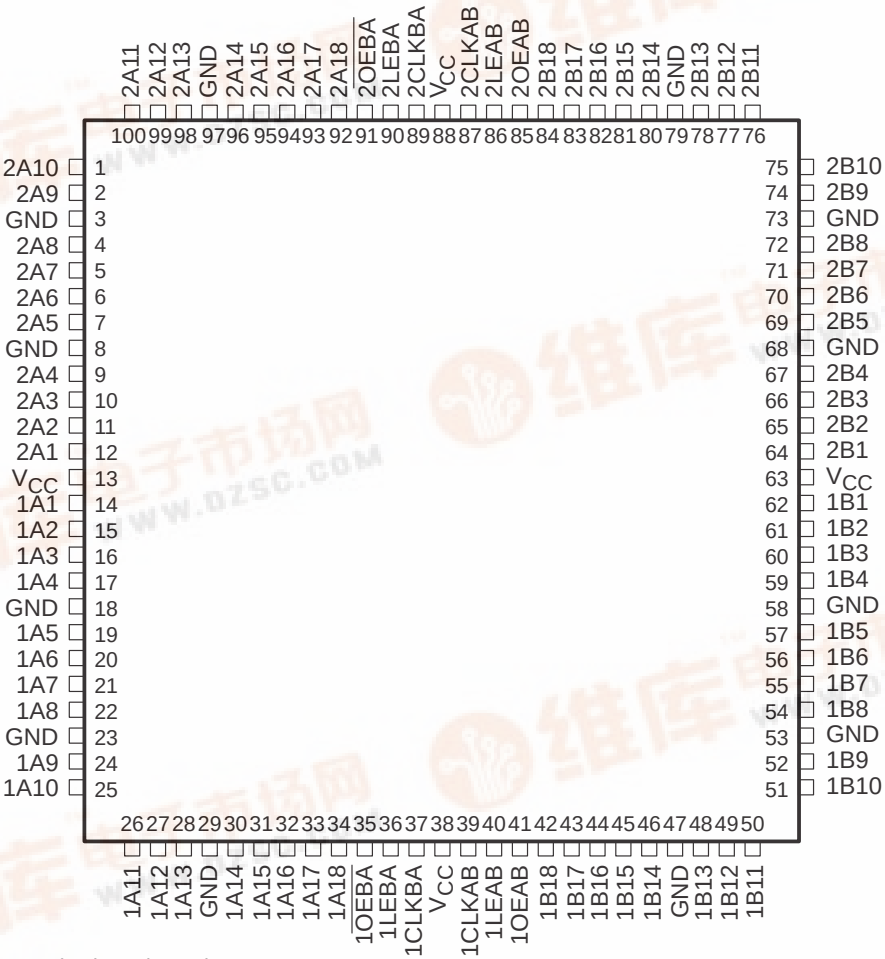
36-BIT UNIVERSAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS229F – JUNE 1992 – REVISED MAY 1997

- Members of the Texas Instruments *Widebus+*™ Family
- State-of-the-Art *EPIC*-II*B*™ BiCMOS Design Significantly Reduces Power Dissipation
- *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-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17
- Released as DSCC SMD 5962-9557601NXD
- Typical V_{OLP} (Output Ground Bounce) < 0.8 V at V_{CC} = 5 V, T_A = 25°C
- High-Impedance State During Power Up and Power Down
- Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise
- High-Drive Outputs (–32-mA I_{OH}, 64-mA I_{OL})
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Package Options Include 100-Pin Plastic Thin Quad Flat (PZ) Package With 14 × 14-mm Body Using 0.5-mm Lead Pitch and Space-Saving 100-Pin Ceramic Quad Flat (HS) Package†

'ABTH32501 . . . PZ PACKAGE
(TOP VIEW)



† The HS package is not production released.

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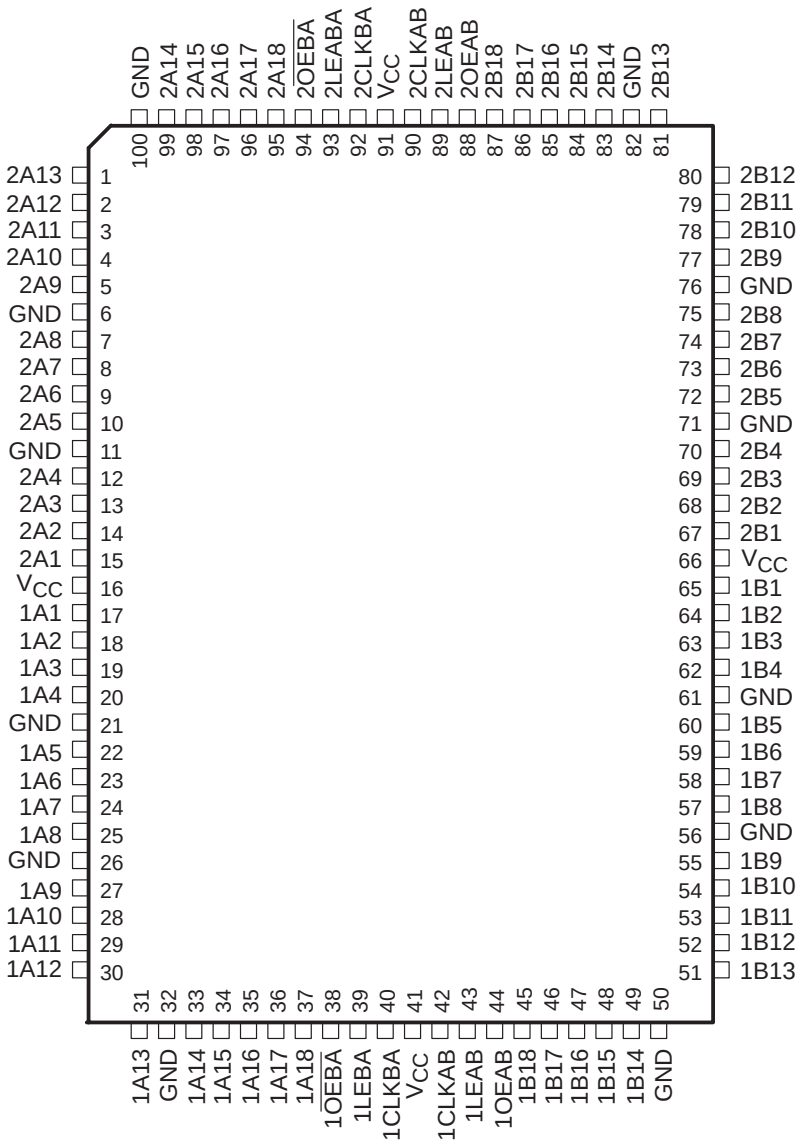
SN54ABTH32501 . . . HS PACKAGE†
(TOP VIEW)



† For HS package availability, please contact the factory or your local TI Field Sales Office.

description

These 36-bit UBTs combine D-type latches and D-type flip-flops to allow data flow in transparent, latched, and clocked modes.

Data flow in each direction is controlled by output-enable (OEAB and $\overline{\text{OEBA}}$), 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 data is stored in the latch/flip-flop on the low-to-high transition of CLKAB. Data flow for B to A is similar to that of A to B, but uses $\overline{\text{OEBA}}$, LEBA, and CLKBA.

Output-enable OEAB is active high. When OEAB is high, the outputs are active. When OEAB is low, the outputs are in the high-impedance state. The output enables are complementary (OEAB is active high, and $\overline{\text{OEBA}}$ is active low).

When V_{CC} is between 0 and 2.1 V, the device is in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 2.1 V, $\overline{\text{OE}}$ should be tied to V_{CC} through a pullup resistor and OE should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sinking/current-sourcing capability of the driver.

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

The SN54ABTH32501 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74ABTH32501 is characterized for operation from –40°C to 85°C.

FUNCTION TABLE†

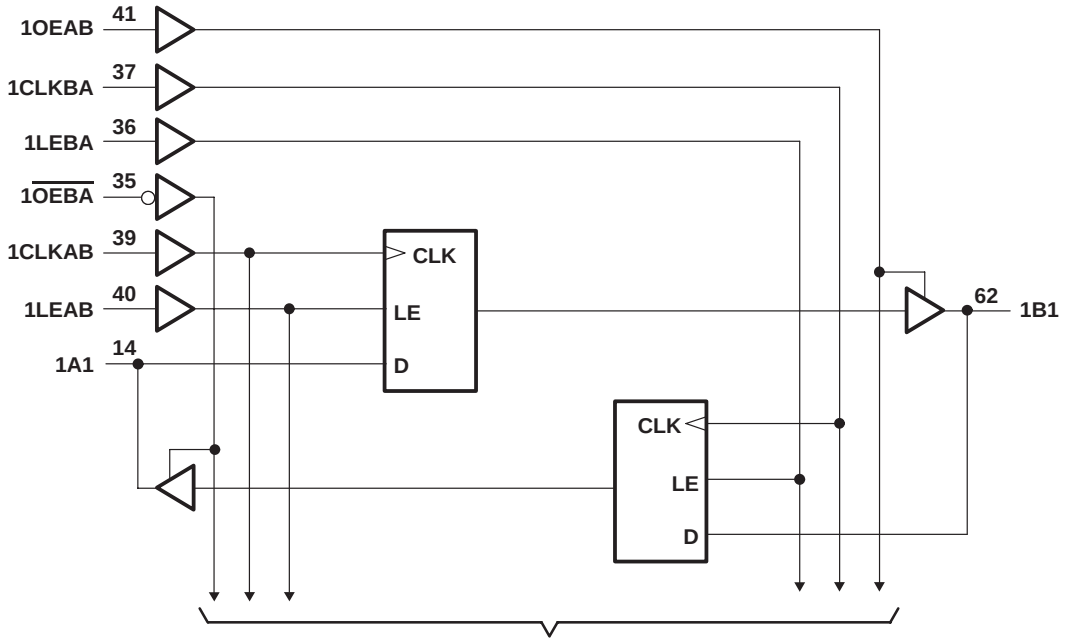
INPUTS				OUTPUT
OEAB	LEAB	CLKAB	A	B
L	X	X	X	Z
H	H	X	L	L
H	H	X	H	H
H	L	↑	L	L
H	L	↑	H	H
H	L	H	X	B_0‡
H	L	L	X	B_0§

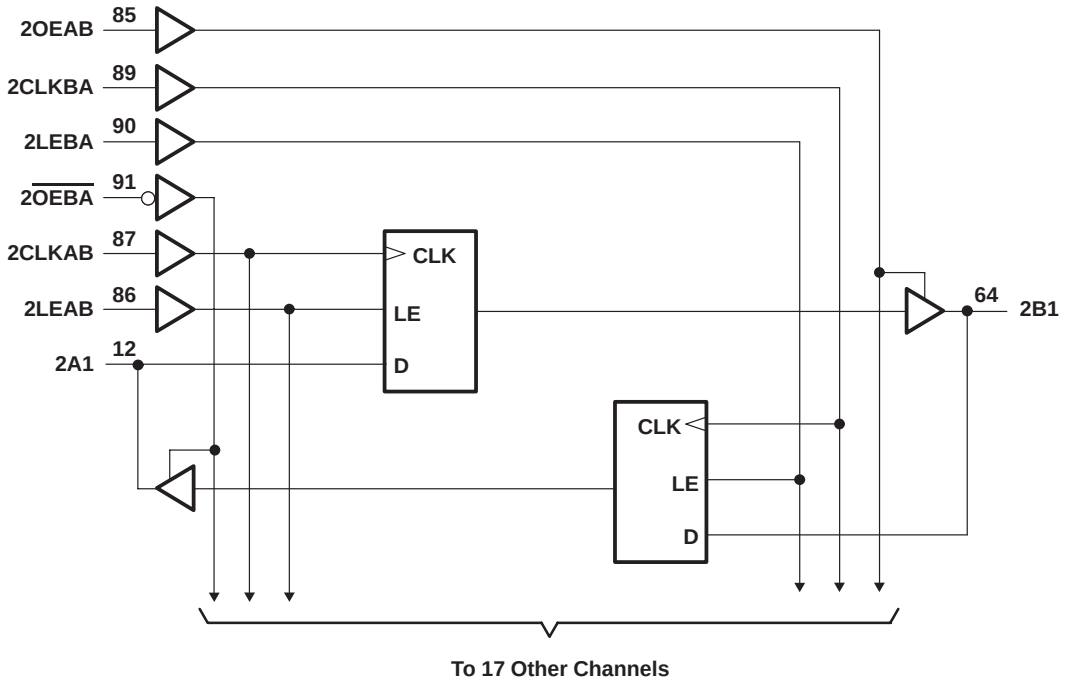
† A-to-B data flow is shown: B-to-A flow is similar, but uses $\overline{\text{OEBA}}$, LEBA, and CLKBA.

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

§ Output level before the indicated steady-state input conditions were established, provided that CLKAB was low before LEAB went low

logic diagram (positive logic)





Pin numbers shown are for the PZ package.

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

Supply voltage range, V_{CC} . . . . . –0.5 V to 7 V
Input voltage range, V_I (except I/O ports) (see Note 1) . . . . . –0.5 V to 7 V
Voltage range applied to any output in the high or power-off state, V_O . . . . . –0.5 V to 5.5 V
Current into any output in the low state, I_O: SN54ABTH32501 . . . . . 96 mA
SN74ABTH32501 . . . . . 128 mA
Input clamp current, I_{IK} (V_I < 0) . . . . . –18 mA
Output clamp current, I_{OK} (V_O < 0) . . . . . –50 mA
Package thermal impedance, θ_{JA} (see Note 2): PZ package . . . . . 50°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. The package thermal impedance is calculated in accordance with EIA/JEDEC Std JESD51.

recommended operating conditions (see Note 3)

			SN54ABTH32501		SN74ABTH32501		UNIT
			MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		4.5	5.5	4.5	5.5	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		0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current			–24		–32	mA
I_{OL}	Low-level output current			48		64	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled		10		10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate		200		200		µs/V
T_A	Operating free-air temperature		–55	125	–40	85	°C

NOTE 3: Unused control pins 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		SN54ABTH32501			SN74ABTH32501			UNIT
				MIN	TYP†	MAX	MIN	TYP†	MAX	
V_{IK}		V_{CC} = 4.5 V,	I_I = –18 mA			–1.2			–1.2	V
V_{OH}		V_{CC} = 4.5 V,	I_{OH} = –3 mA	2.5			2.5			V
		V_{CC} = 5 V,	I_{OH} = –3 mA	3			3			
		V_{CC} = 4.5 V	I_{OH} = –24 mA	2						
			I_{OH} = –32 mA				2			
V_{OL}		V_{CC} = 4.5 V	I_{OL} = 48 mA			0.55			0.55	V
			I_{OL} = 64 mA						0.55	
V_{hys}					100			100		mV
I_I	Control inputs	V_{CC} = 0 to 5.5 V,	V_I = V_{CC} or GND						±1	µA
	A or B ports	V_{CC} = 2.1 V to 5.5 V,	V_I = V_{CC} or GND						±20	
	Control inputs	V_{CC} = 5.5 V,	V_I = V_{CC} or GND			±5				
	A or B ports					±50				
$I_{I(hold)}$	A or B ports	V_{CC} = 4.5 V	V_I = 0.8 V	100			100			µA
			V_I = 2 V	–100			–100			
I_{OZPU}‡		V_{CC} = 0 to 2.1 V, V_O = 0.5 V to 2.7 V, OE or $\overline{OE}$ = X				±50			±50	µA
I_{OZPD}‡		V_{CC} = 2.1 V to 0, V_O = 0.5 V to 2.7 V, OE or $\overline{OE}$ = X				±50			±50	µA
I_{off}		V_{CC} = 0,	V_I or V_O ≤ 4.5 V						±100	µA
I_{CEX}		V_{CC} = 5.5 V, V_O = 5.5 V	Outputs high			50			50	µA
I_O§		V_{CC} = 5.5 V,	V_O = 2.5 V	–50	–100	–180	–50	–100	–180	mA
I_{CC}		V_{CC} = 5.5 V, I_O = 0, V_I = V_{CC} or GND	Outputs high			6			6	mA
			Outputs low			90			90	
			Outputs disabled			6			6	
ΔI_{CC}¶		V_{CC} = 5.5 V, One input at 3.4 V, Other inputs at V_{CC} or GND				1			1	mA
C_i	Control inputs	V_I = 2.5 V or 0.5 V			3.5			3.5		pF
C_{io}	A or B ports	V_O = 2.5 V or 0.5 V			11.5			11.5		pF

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ This parameter is specified by characterization.
§ Not more than one output should be tested at a time, and the duration of the test should not exceed one second.
¶ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1)

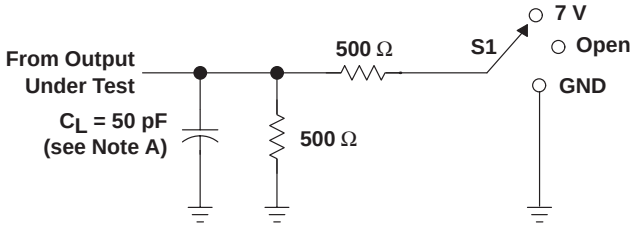
			SN54ABTH32501		SN74ABTH32501		UNIT
			MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		0	150	0	150	MHz
t_w	Pulse duration	LE high	3.5		3.3		ns
		CLK high or low	3.5		3.3		
t_{su}	Setup time	A or B before CLK↑	4.3		3.5		ns
		A or B before LE↓	2.5		1.6		
t_h	Hold time	A or B after CLK↑	0.2		0		ns
		A or B after LE↓	1.8		1.6		

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C_L = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54ABTH32501			SN74ABTH32501			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
f_{max}			150			150			MHz
t_{PLH}	A or B	B or A	0.5	2.9	5.2	1.3	2.9	4.8	ns
t_{PHL}			0.5	2.7	5.8	1.4	2.7	5.4	
t_{PLH}	LEAB or LEBA	A or B	0.7	3.4	5.7	1.6	3.4	5.3	ns
t_{PHL}			0.7	3.6	5.9	1.9	3.6	5.5	
t_{PLH}	CLKAB or CLKBA	A or B	0.5	3.2	5.7	1.5	3.2	5.3	ns
t_{PHL}			0.7	3.3	5.8	1.7	3.3	5.4	
t_{PZH}	OEAB or $\overline{OEBA}$	A or B	0.5	3.2	6.2	1.2	3.2	5.6	ns
t_{PZL}			0.5	3.6	6.6	1.5	3.6	6	
t_{PHZ}	OEAB or $\overline{OEBA}$	A or B	0.7	3.6	7	1.8	3.6	5.9	ns
t_{PLZ}			0.7	3.5	6.1	1.7	3.5	5.6	

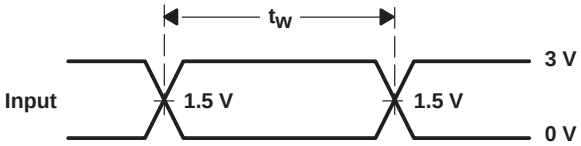
† All typical values are at V_{CC} = 5 V, T_A = 25°C.

PARAMETER MEASUREMENT INFORMATION

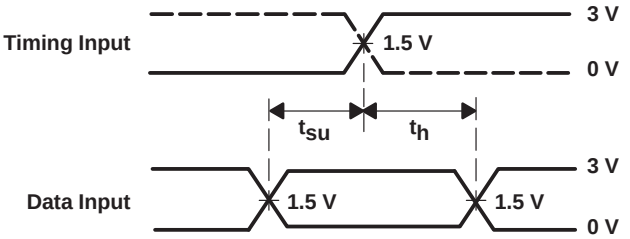


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open

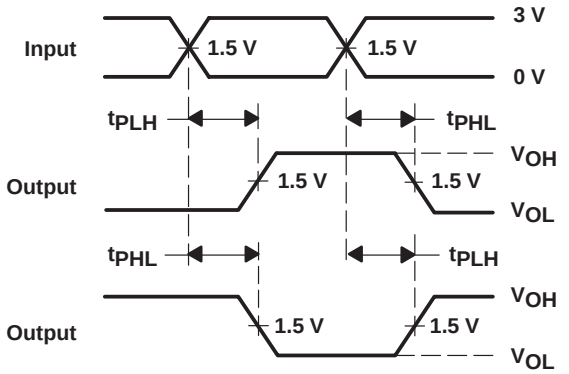
LOAD CIRCUIT



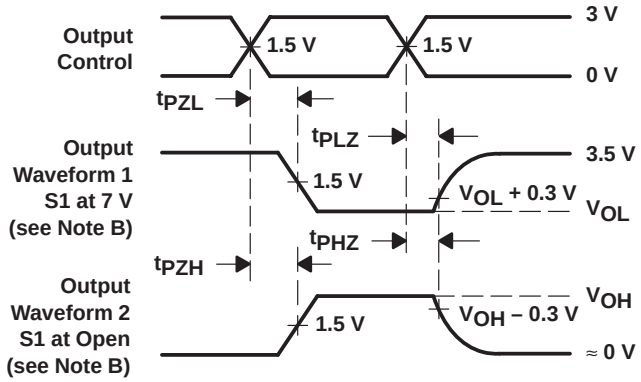
VOLTAGE WAVEFORMS
PULSE DURATION



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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