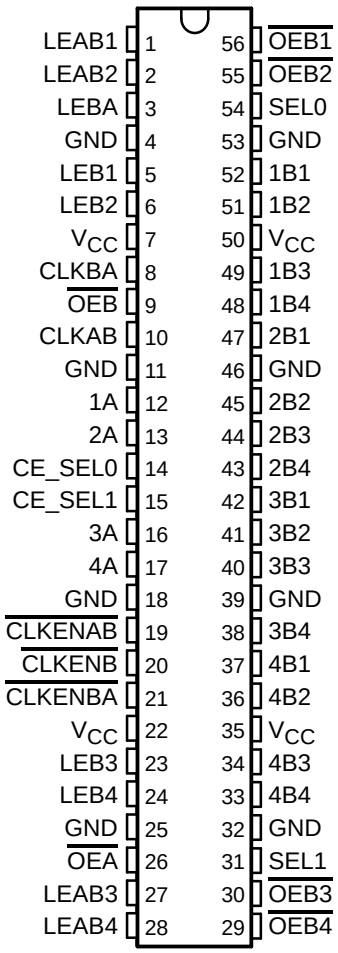
- **Members of the Texas Instruments *Widebus*™ Family**
- **State-of-the-Art *EPIC*-II*B*™ BiCMOS Design Significantly Reduces Power Dissipation**
- **Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17**
- **Typical V_{OLP} (Output Ground Bounce) < 1 V at V_{CC} = 5 V, T_A = 25°C**
- **Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise**
- **Flow-Through Architecture Optimizes PCB Layout**
- **High-Drive Outputs (–32-mA I_{OH}, 64-mA I_{OL})**
- **Bus-Hold Inputs Eliminate the Need for External Pullup Resistors**
- **Package Options Include Plastic 300-mil Shrink Small-Outline (DL) Package and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings**

SN54ABT16460 . . . WD PACKAGE
SN74ABT16460 . . . DL PACKAGE
(TOP VIEW)



description

The ′ABT16460 are 4-bit-to-1-bit multiplexed registered transceivers used in applications where four separate data paths must be multiplexed onto or demultiplexed from a single data path. Typical applications include multiplexing and/or demultiplexing of address and data information in microprocessor- or bus-interface applications. These devices are also useful in memory-interleaving applications.

Five 4-bit I/O ports (1A–4A, 1B1–4, 2B1–4, 3B1–4, and 4B1–4) are available for address and/or data transfer. The output-enable ($\overline{OEB}$, $\overline{OEB1}$–$\overline{OEB4}$, and $\overline{OEA}$) inputs control the bus-transceiver functions. These control signals also allow 4-bit or 16-bit control depending on the $\overline{OEB}$ level.

Address and/or data information can be stored using the internal storage latches/flip-flops. The latch-enable (LEB1–LEB4, LEBA, and LEAB1–LEAB4) and clock/clock-enable (CLK/$\overline{CLKEN}$) inputs are used to control data storage. When either one of the latch-enable inputs is high, the latch is transparent (clock is a don't care as long as the latch-enable is high). When the latch-enable input goes low (providing that the clock does not transit from low to high), the data present at the inputs is latched and remains latched until the latch-enable input is returned high. When the clock-enable is low and the corresponding latch-enable is low, data can be clocked on the low to high transition of the clock. When either the clock-enable or the corresponding latch-enable is high, the clock is a don't care.

Four select pins (SEL0, SEL1, CE_SEL0, and CE_SEL1) are provided to multiplex data (A port), or to select one of four clock-enables (B port). This allows the user to have the flexibility of controlling one bit at a time.

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

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description (continued)

To ensure the high-impedance state during power-up or power-down, $\overline{OE}$ 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 SN74ABT16460 is available in TI's shrink small-outline package (DL), which provides twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The SN54ABT16460 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74ABT16460 is characterized for operation from –40°C to 85°C.

Function Tables

A-TO-B OUTPUT ENABLE†

INPUTS		OUTPUT
$\overline{OEB}$	$\overline{OEBn}$	Bn
H	H	Z
H	L	Z
L	H	Z
L	L	Active

† n = 1, 2, 3, 4

A-TO-B STORAGE
(assuming $\overline{OEB}$ = L, $\overline{OEBn}$ = L)‡

INPUTS								OUTPUTS			
$\overline{CLKENAB}$	CE_SEL1	CE_SEL0	CLKAB	LEAB1	LEAB2	LEAB3	LEAB4	B1	B2	B3	B4
X	X	X	H or L	H	L	L	L	A	A_0	A_0	A_0
X	X	X	H or L	H	H	H	L	A	A	A	A_0
L	X	X	L	L	L	L	L	A_0	A_0	A_0	A_0
L	L	L	↑	L	L	L	L	A	A_0	A_0	A_0
L	L	H	↑	L	L	L	L	A_0	A	A_0	A_0
L	H	L	↑	L	L	L	L	A_0	A_0	A	A_0
L	H	H	↑	L	L	L	L	A_0	A_0	A_0	A
H	X	X	↑	L	L	L	L	A_0	A_0	A_0	A_0

‡ This table does not cover all the latch-enable cases since they have similar results.

Function Tables (Continued)

B-TO-A STORAGE
(before point P)

INPUTS								P
$\overline{\text{CLKENB}}$	CLKBA	LEB1	LEB2	LEB3	LEB4	SEL1	SEL0	
X	X	H	L	L	L	L	L	B1
X	X	L	H	L	L	L	H	B2
X	X	L	L	H	L	H	L	B3
X	X	L	L	L	H	H	H	B4
L	↑	L	L	L	L	L	L	B1
						L	H	B2
						H	L	B3
						H	H	B4
L	L	L	L	L	L	L	L	$B1_0$†
						L	H	$B2_0$†
						H	L	$B3_0$†
						H	H	$B4_0$†

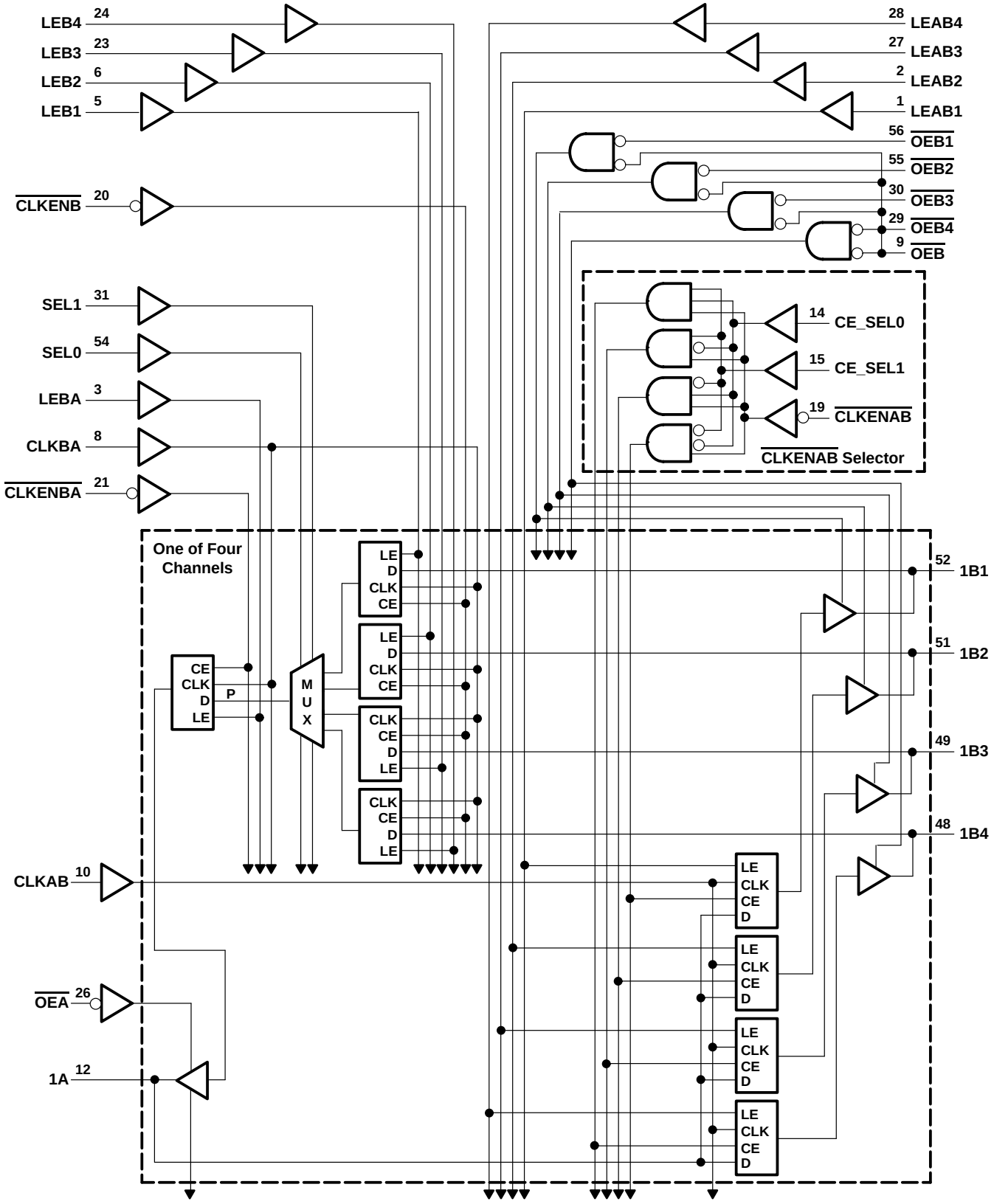
† Output level before the indicated steady-state input conditions were established.

B-TO-A STORAGE
(after point P)

INPUTS					OUTPUT
$\overline{\text{CLKENBA}}$	CLKBA	LEBA	$\overline{\text{OEA}}$	B	A
X	X	X	H	X	Z
X	X	H	L	L	L
X	X	H	L	H	H
H	X	L	L	X	A_0†
L	↑	L	L	L	L
L	↑	L	L	H	H
L	L	L	L	X	A_0†

† 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 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 state or power-off state, V_O . . . . . –0.5 V to 5.5 V
Current into any output in the low state, I_O: SN54ABT16460 . . . . . 96 mA
SN74ABT16460 . . . . . 128 mA
Input clamp current, I_{IK} (V_I < 0) . . . . . –18 mA
Output clamp current, I_{OK} (V_O < 0) . . . . . –50 mA
Maximum power dissipation at T_A = 55°C (in still air) (see Note 2): DL package . . . . . 1.4 W
Storage temperature range . . . . . –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 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.

recommended operating conditions (see Note 3)

			SN54ABT16460		SN74ABT16460		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 or floating pins (input or I/O) must be held high or low.

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

PARAMETER		TEST CONDITIONS		T_A = 25°C			SN54ABT16460		SN74ABT16460		UNIT
				MIN	TYP†	MAX	MIN	MAX	MIN	MAX	
V_{IK}		V_{CC} = 4.5 V,	I_I = –18 mA			–1.2		–1.2		–1.2	V
V_{OH}		V_{CC} = 4.5 V,	I_{OH} = – 3 mA	2.5			2.5		2.5		V
		V_{CC} = 5 V,	I_{OH} = – 3 mA	3			3		3		
		V_{CC} = 4.5 V	I_{OH} = – 24 mA	2			2				
			I_{OH} = – 32 mA	2*					2		
V_{OL}		V_{CC} = 4.5 V	I_{OL} = 48 mA		0.36			0.5			V
			I_{OL} = 64 mA			0.55*				0.55	
I_I	Control inputs	V_{CC} = 0 to 5.5 V, V_I = V_{CC} or GND				±1		±1		±1	µA
	A or B ports	V_{CC} = 2.1 V to 5.5 V, V_I = V_{CC} or GND				±20		±20		±20	
$I_{I(hold)}$	A or B ports	V_{CC} = 4.5 V	V_I = 0.8 V	75		500	75	500	75	500	µA
			V_I = 2 V	–75		–500	–75	–500	–75	–500	
I_{OZPU}‡		V_{CC} = 0 to 2.1 V, V_O = 0.5 to 2.7 V,	$\overline{OE}$ = X			±50		±50		±50	µA
I_{OZPD}‡		V_{CC} = 2.1 V to 0, V_O = 0.5 to 2.7 V,	$\overline{OE}$ = X			±50		±50		±50	µA
I_{OZH}§		V_{CC} = 2.1 V to 5.5 V, V_O = 2.7 V,	$\overline{OE}$ ≥ 2 V			10		10		10	µA
I_{OZL}§		V_{CC} = 2.1 V to 5.5 V, V_O = 0.5 V,	$\overline{OE}$ ≥ 2 V			–10		–10		–10	µA
I_{off}		V_{CC} = 0,	V_I or V_O ≤ 4.5 V			±100				±100	µA
I_{CEX}	Outputs high	V_{CC} = 5.5 V,	V_O = 5.5 V			50		50		50	µA
I_O¶		V_{CC} = 5.5 V,	V_O = 2.5 V	– 50	–100	–200	– 50	–200	– 50	–200	mA
I_{CC}	Outputs high	V_{CC} = 5.5 V, V_I = V_{CC} or GND	I_O = 0,			1.5		1.5		1.5	mA
	A outputs low					10		10		10	
	B outputs low					32		32		32	
	Outputs disabled					1.5		1.5		1.5	
ΔI_{CC}#		V_{CC} = 5.5 V, One input at 3.4 V, Other inputs at V_{CC} or GND				1.5		1.5		1.5	mA
C_i	Control inputs	V_I = 2.5 V or 0.5 V			8						pF
C_{io}	A or B ports	V_O = 2.5 V or 0.5 V			3.5						pF

* On products compliant to MIL-STD-883, Class B, this parameter does not apply.
† All typical values are at V_{CC} = 5 V.
‡ This parameter is characterized but not tested.
§ The parameters I_{OZH} and I_{OZL} include the input leakage current.
¶ 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.

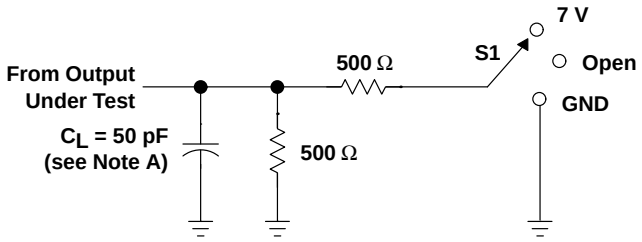
timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

				SN54ABT16460		SN74ABT16460		UNIT
				MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency			0	160	0	160	MHz
t_w	Pulse duration	CLKAB high or low		3.8		3.8		ns
		CLKBA high or low		4.5		4.5		
		LEAB1, 2, 3, or 4 high		2.2		2.2		
		LEBA high		2.1		2.1		
		LEB1, 2, 3, or 4 high		2.4		2.4		
t_{su}	Setup time	Before CLKAB↑	A bus	2.5		2.5		ns
			CE_SEL0/1	3.2		3.2		
			$\overline{\text{CLKENAB}}$	3.2		3.2		
		Before LEAB1, 2, 3, or 4 ↓	A bus	3.6		3.6		
		Before CLKBA↑	B bus	3.8		3.8		
			$\overline{\text{CLKENB}}$	2.3		2.3		
			CLKENBA	2.5		2.5		
			LEB1, 2, 3, or 4	4.3		4.3		
			SEL0/1	4.5		4.5		
		Before LEB1, 2, 3, or 4 ↓	B bus	3.2		3.2		
		Before LEBA↓	B bus	4		4		
			LEB1, 2, 3, or 4	4.4		4.4		
			SEL0/1	4.3		4.3		
t_h	Hold time	After CLKAB↑	A bus	0.5		0.5		ns
			CE_SEL0/1	1.1		1.1		
			CLKENAB	0.5		0.5		
		After LEAB1, 2, 3, or 4 ↓	A bus	1.2		1.2		
		After CLKBA↑	B bus	1.3		1.3		
			$\overline{\text{CLKENB}}$	1		1		
			CLKENBA	1		1		
			SEL0/1	0		0		
		After LEB1, 2, 3, or 4 ↓	B bus	1.5		1.5		
		After LEBA↓	B bus	0.4		0.4		
			SEL0/1	0.1		0.1		

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

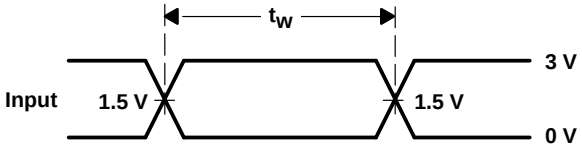
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 5 V, T_A = 25°C			SN54ABT16460		SN74ABT16460		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			160			160		160		MHz
t_{PLH}	B	A	2.5	3.6	5.9	2.5	7.1	2.5	6.5	ns
t_{PHL}			2	3.5	5.8	2	6.8	2	6.5	
t_{PZH}	$\overline{OEA}$	A	1.5	2.8	4.8	1.5	5.9	1.5	5.6	ns
t_{PZL}			1.5	2.6	4.6	1.5	5.5	1.5	5.2	
t_{PHZ}	$\overline{OEA}$	A	2.5	3.8	5.3	2.5	6	2.5	5.9	ns
t_{PLZ}			1.5	4.6	6.1	1.5	7	1.5	6.5	
t_{PLH}	A	B	2	3.2	5.2	2	6.2	2	5.7	ns
t_{PHL}			1.5	3.1	5.2	1.5	6.1	1.5	5.7	
t_{PZH}	$\overline{OEB}$	B	1.5	3.3	5.7	1.5	6.7	1.5	6.4	ns
t_{PZL}			1.5	3.2	5.5	1.5	6.6	1.5	6.3	
t_{PHZ}	$\overline{OEB}$	B	3	4.7	6.3	3	7.1	3	7	ns
t_{PLZ}			2	4	5.5	2	6.6	2	6.1	
t_{PZH}	$\overline{OEB1}$, $\overline{2}$, $\overline{3}$, $\overline{4}$	B	1.5	3	5.2	1.5	6	1.5	5.8	ns
t_{PZL}			1.5	2.9	4.9	1.5	5.9	1.5	5.6	
t_{PHZ}	$\overline{OEB1}$, $\overline{2}$, $\overline{3}$, $\overline{4}$	B	2.5	4	5.7	2.5	6.2	2.5	6.1	ns
t_{PLZ}			1.5	3.5	4.8	1.5	5.8	1.5	5.3	
t_{PLH}	CLKBA	A	1.5	4.2	6.7	1.5	8.1	1.5	7.4	ns
t_{PHL}			1.5	4.4	6.9	1.5	8.4	1.5	7.7	
t_{PLH}	CLKAB	B	2	3.4	5.6	2	6.8	2	6.2	ns
t_{PHL}			2	3.4	5.3	2	6.3	2	5.9	
t_{PLH}	LEBA	A	2	3	5	2	6.1	2	5.6	ns
t_{PHL}			2	3.1	4.8	2	5.8	2	5.3	
t_{PLH}	LEAB1, 2, 3, 4	B	2	3.2	5.2	2	6.3	2	5.8	ns
t_{PHL}			2	3.3	5	2	6.1	2	5.6	
t_{PLH}	LEBA1, 2, 3, 4	A	2.5	4	6.5	2.5	7.8	2.5	7.2	ns
t_{PHL}			2.5	4	6.1	2.5	7.5	2.5	6.8	
t_{PLH}	SEL	A	2	4.1	6.7	2	8.1	2	7.5	ns
t_{PHL}			2	3.8	6.2	2	7.3	2	6.9	

PARAMETER MEASUREMENT INFORMATION

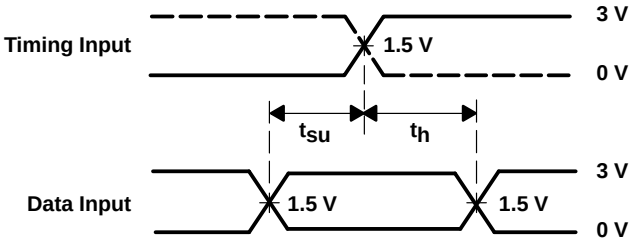


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open

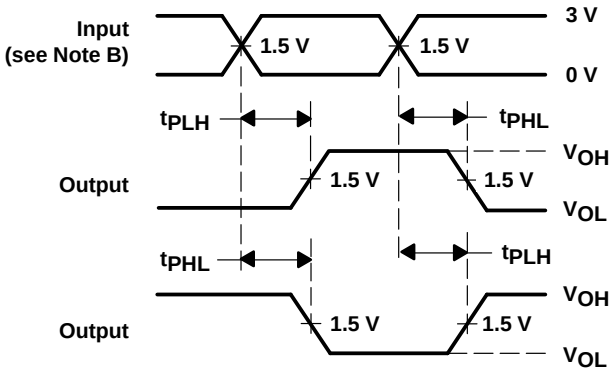
LOAD CIRCUIT FOR OUTPUTS



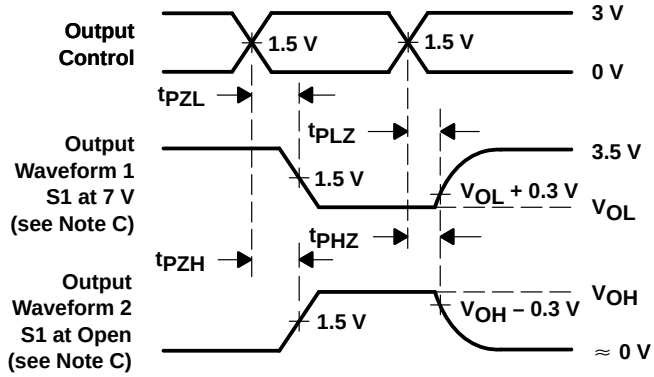
VOLTAGE WAVEFORMS
PULSE DURATION



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. 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.
C. 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.
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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