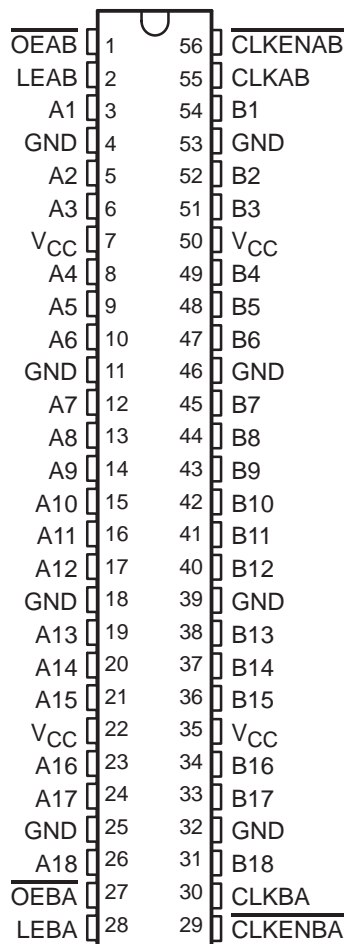


SN54ABT16601, SN74ABT16601 18-BIT UNIVERSAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS210C – JUNE 1992 – REVISED JANUARY 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, Clocked, or Clock-Enabled Mode**
- **Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17**
- **Typical V_{OLP} (Output Ground Bounce) < 0.8 V at $V_{CC} = 5 V$, $T_A = 25^\circ C$**
- **Flow-Through Architecture Optimizes PCB Layout**
- **Package Options Include Plastic 300-mil Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings**

SN54ABT16601 . . . WD PACKAGE
SN74ABT16601 . . . DGG OR DL PACKAGE
(TOP VIEW)



description

These 18-bit universal bus transceivers combine D-type latches and D-type flip-flops to allow data flow in transparent, latched, clocked, and clock-enabled modes.

Data flow in each direction is controlled by output-enable (\overline{OEAB} and \overline{OEBA}), latch-enable (LEAB and LEBA), and clock (CLKAB and CLKBA) inputs. The clock can be controlled by the clock-enable ($\overline{CLKENAB}$ and $\overline{CLKENBA}$) 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. Output enable \overline{OEAB} is active low. When \overline{OEAB} is low, the outputs are active. When \overline{OEAB} is high, 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, CLKBA, and $\overline{CLKENBA}$.

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 SN54ABT16601 is characterized for operation over the full military temperature range of $-55^\circ C$ to $125^\circ C$. The SN74ABT16601 is characterized for operation from $-40^\circ C$ to $85^\circ C$.



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FUNCTION TABLE†

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

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

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

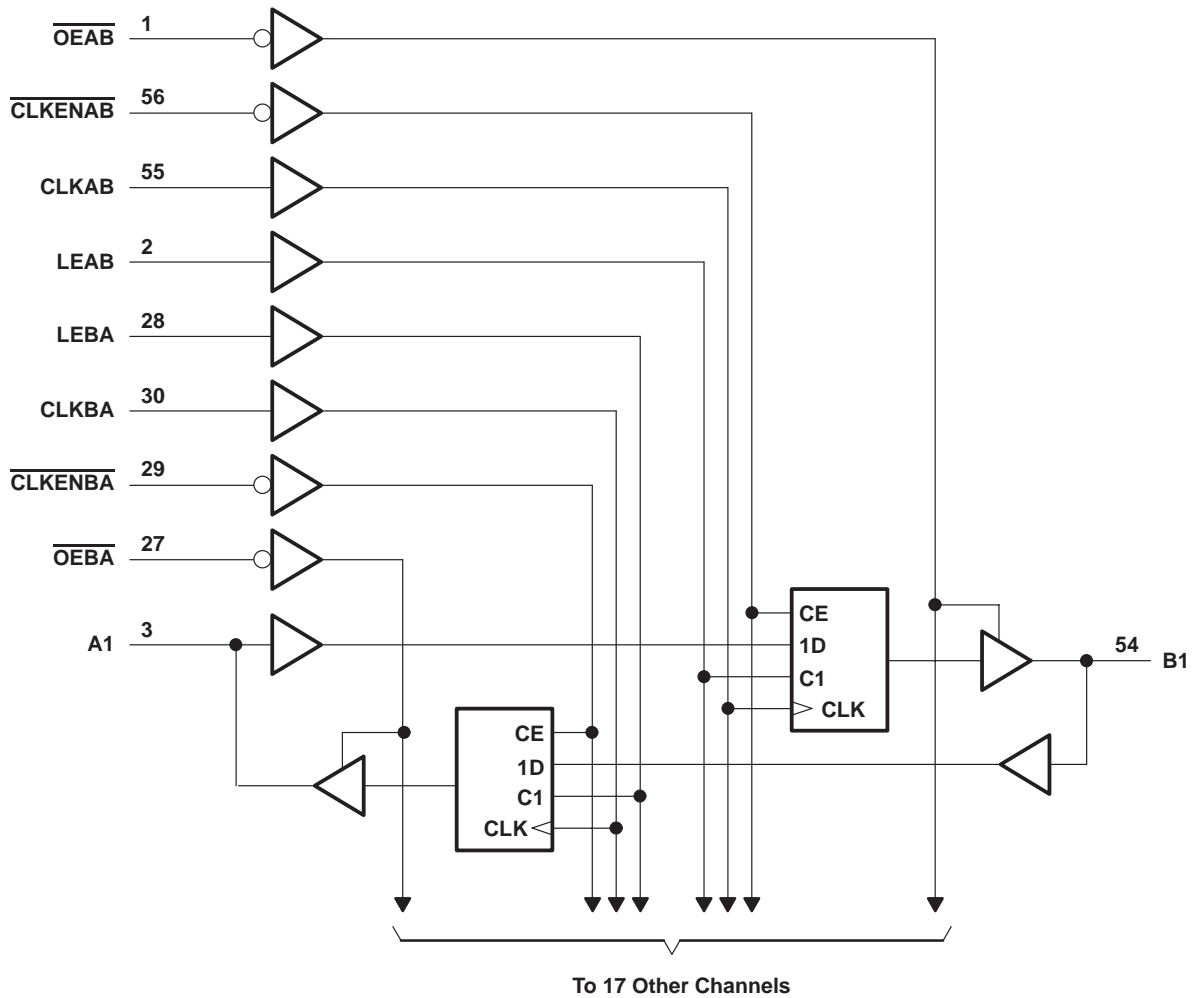
§ Output level before the indicated steady-state input conditions were established, provided that CLKAB was low before LEAB went low



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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 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_{OL} : SN54ABT16601	96 mA
SN74ABT16601	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): 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. The package thermal impedance is calculated in accordance with EIA/JEDEC Std JESD51.



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WITH 3-STATE OUTPUTS

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recommended operating conditions (see Note 3)

		SN54ABT16601		SN74ABT16601		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
Δt/Δv	Input transition rise or fall rate	Outputs enabled		10	10	ns/V
T _A	Operating free-air temperature	-55	125	-40	85	°C

NOTE 3: Unused pins (input or I/O) 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	T _A = 25°C			SN54ABT16601		SN74ABT16601		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		0.55		0.55			V	
		I _{OL} = 64 mA		0.55*			0.55			
V _{hys}			100						mV	
I _I	Control inputs	V _{CC} = 5.5 V, V _I = V _{CC} or GND		±1		±1		±1	μA	
	A or B ports			±20**		±100		±20		
I _{off}	V _{CC} = 0, V _I or V _O ≤ 4.5 V			±100				±100	μA	
I _{CEX}	V _{CC} = 5.5 V, V _O = 5.5 V	Outputs high		50		50		50	μA	
I _O ‡	V _{CC} = 5.5 V, V _O = 2.5 V		-50	-100	-180	-50	-180	-50	-180	mA
I _{OZH} §	V _{CC} = 5.5 V, V _O = 2.7 V			10		10		10	μA	
I _{OZL} §	V _{CC} = 5.5 V, V _O = 0.5 V			-10		-10		-10	μA	
I _{CC}	A or B ports	V _{CC} = 5.5 V, I _O = 0, V _I = V _{CC} or GND	Outputs high	1.9	3		2		3	mA
		Outputs low	28	36		35		36		
		Outputs disabled	1.6	3		2		3		
ΔI _{CC} ¶	V _{CC} = 5.5 V, One input at 3.4 V, Other inputs at V _{CC} or GND			50				50	μA	
						1.5			mA	
C _i	Control inputs	V _I = 2.5 V or 0.5 V		3					pF	
C _{io}	A or B ports	V _O = 2.5 V or 0.5 V		9					pF	

* On products compliant to MIL-PRF-38535, this parameter does not apply.

** This limit applies only to the SN74ABT16601.

† All typical values are at V_{CC} = 5 V.

‡ Not more than one output should be tested at a time, and the duration of the test should not exceed one second.

§ The parameters I_{OZH} and I_{OZL} include the input leakage current.

¶ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.



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

			SN54ABT16601		SN74ABT16601		UNIT	
			MIN	MAX	MIN	MAX		
f_{clock}	Clock frequency		0	150	0	150	MHz	
t_w	Pulse duration	LEAB or LEBA high	2.5		2.5		ns	
		CLKAB or CLKBA high or low	3		3			
t_{su}	Setup time	A before CLKAB \uparrow or B before CLKBA \uparrow	4.6		4		ns	
		A before LEAB \downarrow or B before LEBA \downarrow	CLK high	2.5		2.5		
			CLK low	1.3		1		
		CLKEN before CLK \uparrow	2.9		2.5			
t_h	Hold time	A after CLKAB \uparrow or B after CLKBA \uparrow	0.4		0		ns	
		A after LEAB \downarrow or B after LEBA \downarrow	2.8		2			
		CLKEN after CLK \uparrow	0		0			

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)	SN54ABT16601				UNIT	
			$V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$			MIN		MAX
			MIN	TYP	MAX			
f_{max}			150	200		150	MHz	
t_{PLH}	A or B	B or A	1.5	2.5	4.1	1	4.6	ns
t_{PHL}			1.5	3.4	4.7	1	5.1	
t_{PLH}	LEAB or LEBA	B or A	2	3.4	4.7	1	5.6	ns
t_{PHL}			2	3.7	5	1	5.5	
t_{PLH}	CLKAB or CLKBA	B or A	1.5	3.2	4.5	1	5.2	ns
t_{PHL}			1.5	3.2	4.4	1	5	
t_{PZH}	$\overline{\text{OEAB}}$ or $\overline{\text{OEBA}}$	B or A	2	4	5	1	5.7	ns
t_{PZL}			2	4.2	5.6	1	6	
t_{PHZ}	$\overline{\text{OEAB}}$ or $\overline{\text{OEBA}}$	B or A	2	4.5	5.8	1	6.8	ns
t_{PLZ}			1.5	3.4	5.3	1	6.3	

SN54ABT16601, SN74ABT16601
18-BIT UNIVERSAL BUS TRANSCEIVERS
WITH 3-STATE OUTPUTS

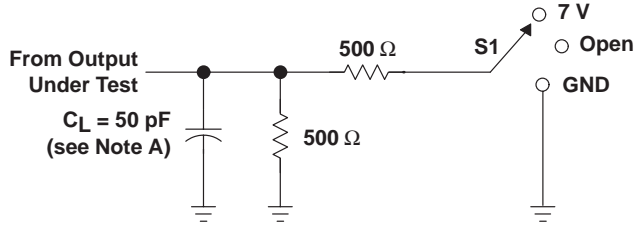
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switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L = 50$ pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74ABT16601				UNIT	
			$V_{CC} = 5$ V, $T_A = 25^\circ$ C			MIN		MAX
			MIN	TYP	MAX			
f_{max}			150	200		150	MHz	
t_{PLH}	A or B	B or A	1.5	2.5	3.6	1.5	4	ns
t_{PHL}			1.5	3.4	4.7	1.5	4.9	
t_{PLH}	LEAB or LEBA	B or A	2	3.4	4.7	2	5	ns
t_{PHL}			2	3.7	5	2	5.2	
t_{PLH}	CLKAB or CLKBA	B or A	1.5	3.2	4.5	1.5	4.7	ns
t_{PHL}			1.5	3.2	4.4	1.5	4.6	
t_{PZH}	\overline{OEAB} or \overline{OEBA}	B or A	2	4	5	2	5.5	ns
t_{PZL}			2	4.2	5.6	2	5.8	
t_{PHZ}	\overline{OEAB} or \overline{OEBA}	B or A	2	4.5	5.4	2	6.2	ns
t_{PLZ}			1.5	3.4	4.7	1.5	5.4	

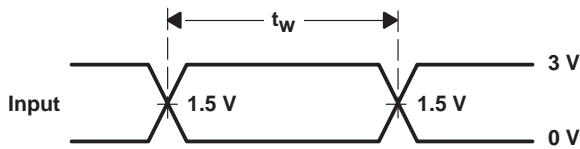


PARAMETER MEASUREMENT INFORMATION

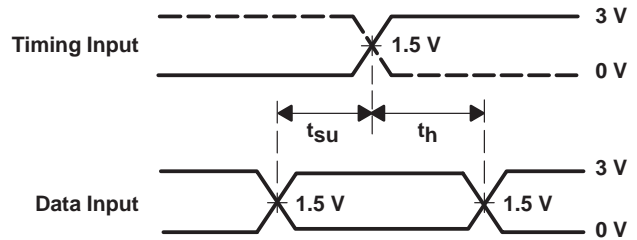


LOAD CIRCUIT

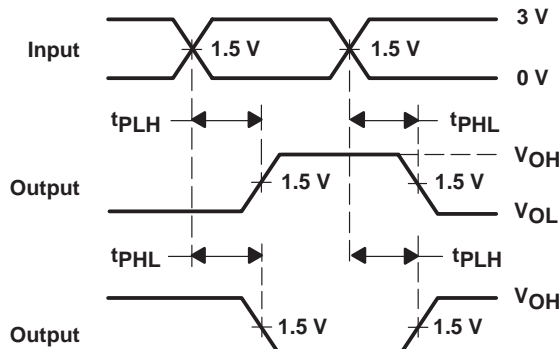
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open



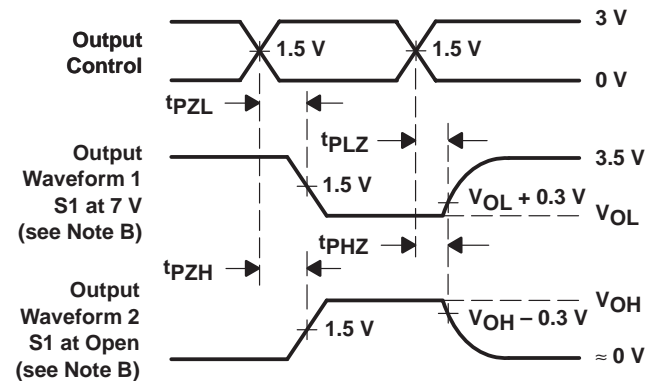
VOLTAGE WAVEFORMS
PULSE DURATION



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: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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