

SN54ABT651, SN74ABT651 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

SCBS083C – JANUARY 1991 – REVISED JULY 1994

- State-of-the-Art *EPIC-IITM* BiCMOS Design Significantly Reduces Power Dissipation
- 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 500 mA Per JEDEC Standard JESD-17
- Typical V_{OLP} (Output Ground Bounce) < 1 V at $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$
- High-Drive Outputs (–32-mA I_{OH} , 64-mA I_{OL})
- Multiplexed Real-Time and Stored Data
- Inverting Data Paths
- Package Options Include Plastic Small-Outline (DW) and Shrink Small-Outline (DB) Packages, Ceramic Chip Carriers (FK), and Plastic (NT) and Ceramic (JT) DIPs

description

These devices consist of bus transceiver circuits, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. Output-enable (OEAB and $\overline{\text{OEBA}}$) inputs are provided to control the transceiver functions. The select-control (SAB and SBA) inputs are provided to select whether real-time or stored data is transferred. A low input level selects real-time data, and a high input level selects stored data. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the 'ABT651.

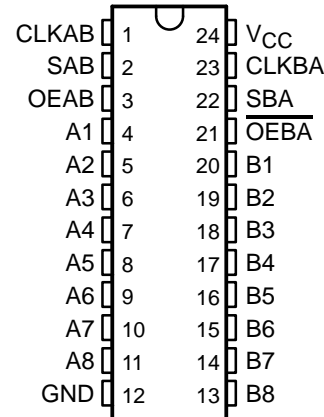
Data on the A or B bus, or both, can be stored in the internal D flip-flops by low-to-high transitions at the appropriate clock (CLKAB or CLKBA) inputs regardless of the select- or enable-control pins. When SAB and SBA are in the real-time transfer mode, it is also possible to store data without using the internal D-type flip-flops by simultaneously enabling OEAB and $\overline{\text{OEBA}}$. In this configuration, each output reinforces its input. When all the other data sources to the two sets of bus lines are at high impedance, each set remains at its last state.

To ensure the high-impedance state during power up or power down, $\overline{\text{OEBA}}$ 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 (B to A). OEAB should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver (A to B).

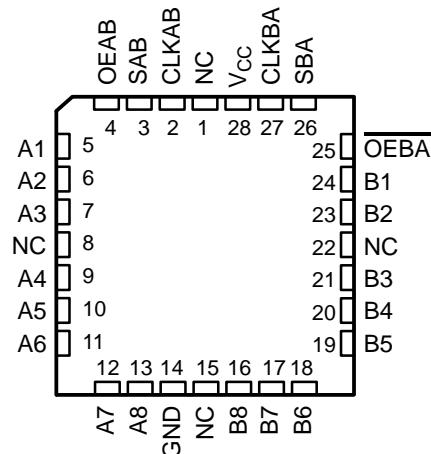
The SN74ABT651 is available in TI's shrink small-outline package (DB), which provides the same I/O pin count and functionality of standard small-outline packages in less than half the printed-circuit-board area.

The SN54ABT651 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74ABT651 is characterized for operation from -40°C to 85°C .

SN54ABT651 ... JT PACKAGE
SN74ABT651 ... DB, DW, OR NT PACKAGE
(TOP VIEW)



SN54ABT651 ... FK PACKAGE
(TOP VIEW)



NC – No internal connection

EPIC-II^B is a trademark of Texas Instruments Incorporated.

UNLESS OTHERWISE NOTED this document contains PRODUCTION DATA information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 1994, Texas Instruments Incorporated

SN54ABT651, SN74ABT651

OCTAL BUS TRANSCEIVERS AND REGISTERS

WITH 3-STATE OUTPUTS

SCBS083C – JANUARY 1991 – REVISED JULY 1994

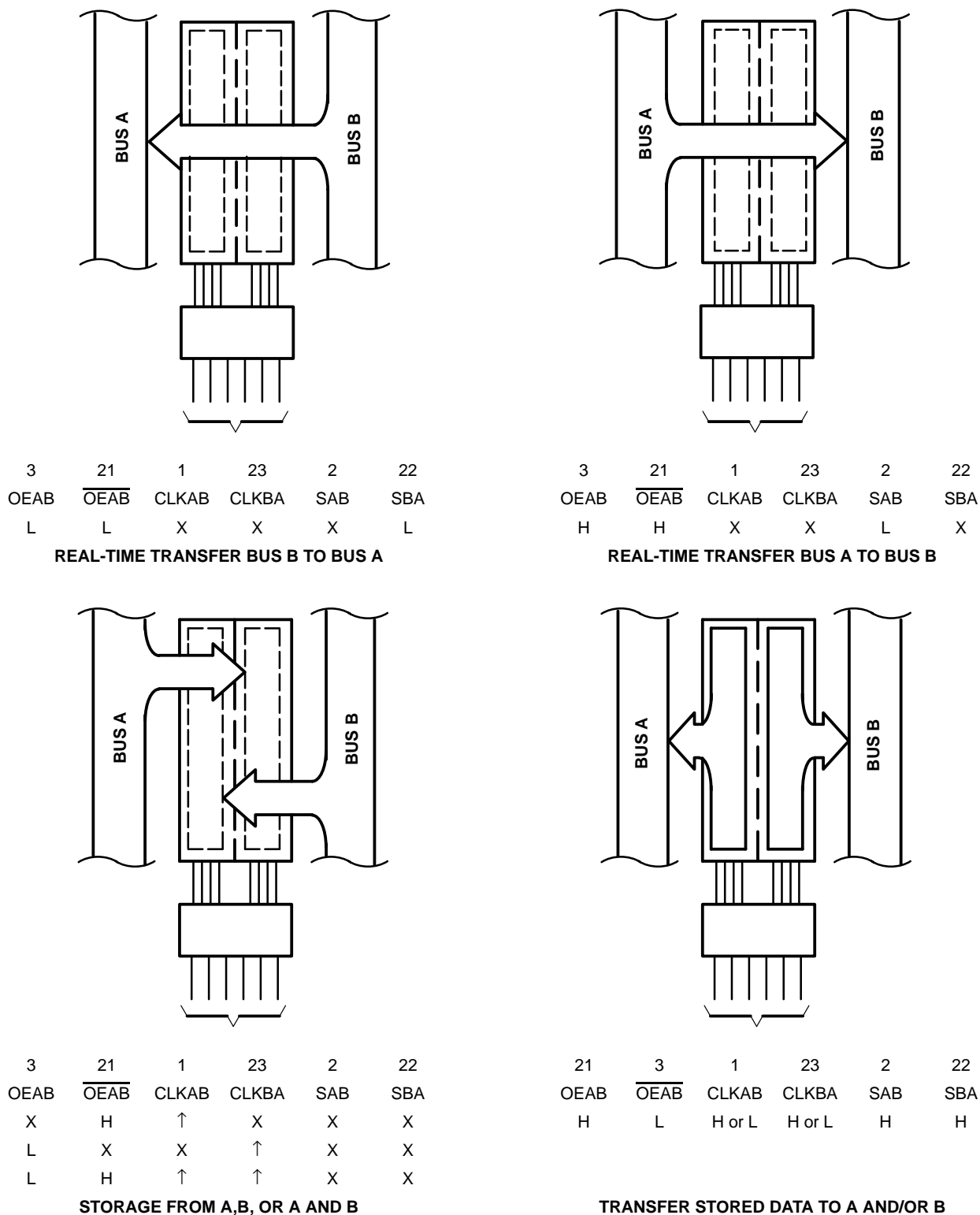


Figure 1. Bus-Management Functions

Pin numbers shown are for the DB, DW, JT, and NT packages.

SN54ABT651, SN74ABT651

OCTAL BUS TRANSCEIVERS AND REGISTERS

WITH 3-STATE OUTPUTS

SCBS083C – JANUARY 1991 – REVISED JULY 1994

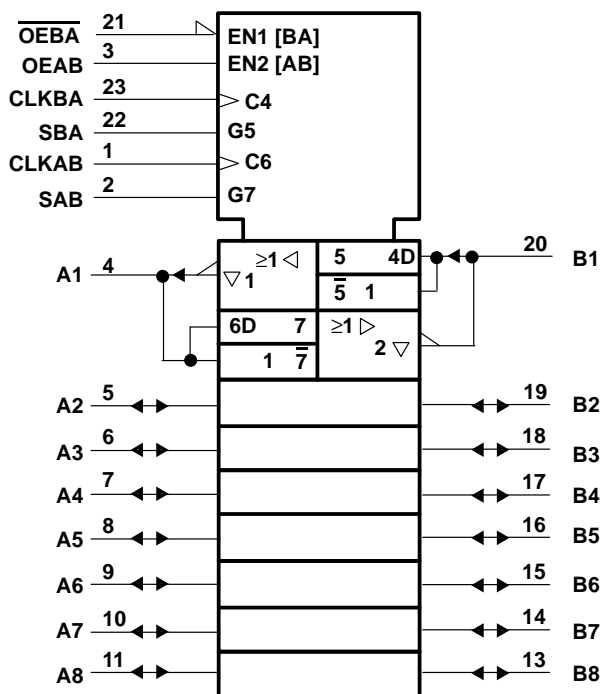
FUNCTION TABLE

INPUTS						DATA I/O		OPERATION OR FUNCTION
OEAB	OEBA	CLKAB	CLKBA	SAB	SBA	A1 THRU A8	B1 THRU B8	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	↑	↑	X	X	Input	Input	Store A and B data
X	H	↑	H or L	X	X	Input	Unspecified†	Store A, hold B
H	H	↑	↑	X‡	X	Input	Output	Store A in both registers
L	X	H or L	↑	X	X	Unspecified†	Input	Hold A, store B
L	L	↑	↑	X	X‡	Output	Input	Store B in both registers
L	L	X	X	X	L	Output	Input	Real-time \overline{B} data to A bus
L	L	X	H or L	X	H	Output	Input	Stored \overline{B} data to A bus
H	H	X	X	L	X	Input	Output	Real-time \overline{A} data to B bus
H	H	H or L	X	H	X	Input	Output	Stored \overline{A} data to B bus
H	L	H or L	H or L	H	H	Output	Output	Stored \overline{A} data to B bus and stored B data to A bus

† The data output functions may be enabled or disabled by various signals at the OEAB or OEBA inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every low-to-high transition on the clock inputs.

‡ When select control is low, clocks can occur simultaneously so long as allowances are made for propagation delays from A to B (B to A) plus setup and hold times. When select control is high, clocks must be staggered in order to load both registers.

logic symbol§



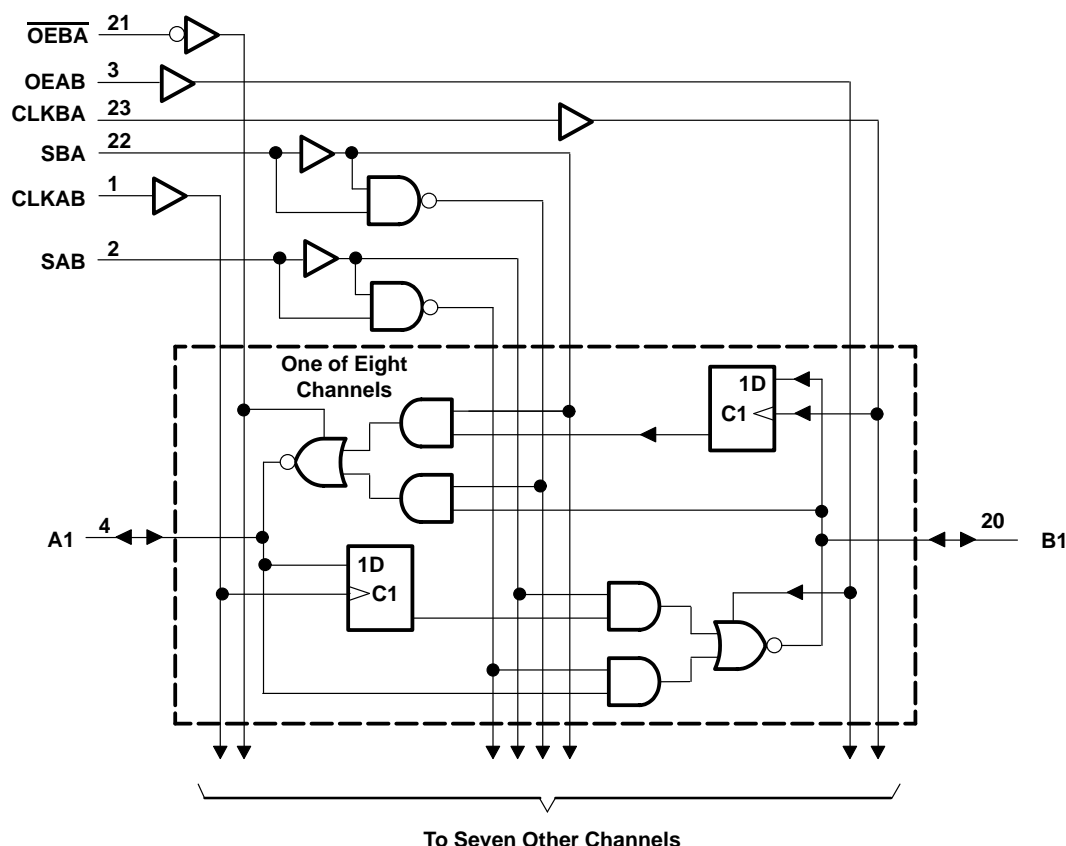
§ This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Pin numbers shown are for the DB, DW, JT, and NT packages.

SN54ABT651, SN74ABT651 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

SCBS083C – JANUARY 1991 – REVISED JULY 1994

logic diagram (positive logic)



Pin numbers shown are for the DB, DW, JT, and NT packages.

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 : SN54ABT651	96 mA
SN74ABT651	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 $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): DB package	0.65 W
DW package	1.7 W
NT package	1.3 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, except for the NT package, which has a trace length of zero. For more information, refer to the *Package Thermal Considerations* application note in the 1994 *ABT Advanced BiCMOS Technology Data Book*, literature number SCBD002B.

SN54ABT651, SN74ABT651

OCTAL BUS TRANSCEIVERS AND REGISTERS

WITH 3-STATE OUTPUTS

SCBS083C – JANUARY 1991 – REVISED JULY 1994

recommended operating conditions (see Note 3)

		SN54ABT651		SN74ABT651		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		5		5	ns/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	$T_A = 25^\circ\text{C}$			SN54ABT651		SN74ABT651		UNIT
					MIN	MAX	MIN	MAX	
V_{IK}	$V_{CC} = 4.5\text{ V}$, $I_I = -18\text{ mA}$			–1.2		–1.2		–1.2	V
V_{OH}	$V_{CC} = 4.5\text{ V}$, $I_{OH} = -3\text{ mA}$			2.5		2.5		2.5	V
	$V_{CC} = 5\text{ V}$, $I_{OH} = -3\text{ mA}$			3		3		3	
	$V_{CC} = 4.5\text{ V}$	$I_{OH} = -24\text{ mA}$		2		2			
		$I_{OH} = -32\text{ mA}$		2*				2	
V_{OL}	$V_{CC} = 4.5\text{ V}$	$I_{OL} = 48\text{ mA}$				0.55			V
		$I_{OL} = 64\text{ mA}$				0.55*		0.55	
I_I	$V_{CC} = 5.5\text{ V}$, $V_I = V_{CC}$ or GND	Control inputs		± 1		± 1		± 1	μA
		A or B ports		± 100		± 100		± 100	
I_{OZH}^\ddagger	$V_{CC} = 5.5\text{ V}$, $V_O = 2.7\text{ V}$			50		50		50	μA
I_{OZL}^\ddagger	$V_{CC} = 5.5\text{ V}$, $V_O = 0.5\text{ V}$			–50		–50		–50	μA
I_{off}	$V_{CC} = 0$, V_I or $V_O \leq 4.5\text{ V}$			± 100				± 100	μA
I_{CEX}	$V_{CC} = 5.5\text{ V}$, $V_O = 5.5\text{ V}$	Outputs high		50		50		50	μA
I_O^\S	$V_{CC} = 5.5\text{ V}$, $V_O = 2.5\text{ V}$			–50 –100 –180	–50	–180	–50	–180	mA
I_{CC}	$V_{CC} = 5.5\text{ V}$, $V_I = V_{CC}$ or GND $I_O = 0$	Outputs high		250		250		250	μA
		Outputs low		30		30		30	mA
		Outputs disabled		250		250		250	μA
ΔI_{CC}^\P	$V_{CC} = 5.5\text{ V}$, One input at 3.4 V, Other inputs at V_{CC} or GND			1.5		1.5		1.5	mA
C_i	$V_I = 2.5\text{ V}$ or 0.5 V	Control inputs		6					pF
C_{io}	$V_O = 2.5\text{ V}$ or 0.5 V	A or B ports		7.5					pF

* On products compliant to MIL-STD-883, Class B, this parameter does not apply.

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

‡ 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.

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

SN54ABT651, SN74ABT651

OCTAL BUS TRANSCEIVERS AND REGISTERS

WITH 3-STATE OUTPUTS

SCBS083C – JANUARY 1991 – REVISED JULY 1994

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 2)

		V _{CC} = 5 V, T _A = 25°C		SN54ABT651		SN74ABT651		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
f _{clock}	Clock frequency	0	125	0	125	0	125	MHz
t _w	Pulse duration, CLK high or low	4		4		4		ns
t _{su}	Setup time, A or B before CLKAB↑ or CLKBA↑	3		3		3		ns
t _h	Hold time, A or B after CLKAB↑ or CLKBA↑	0		0		0		ns

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C_L = 50 pF (unless otherwise noted) (see Figure 2)

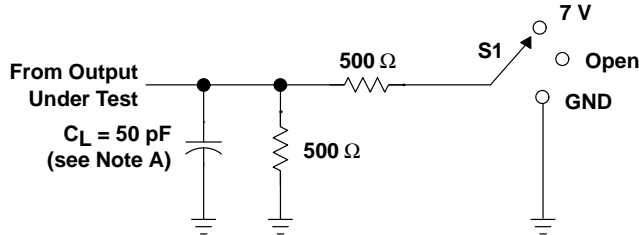
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC} = 5 V, T _A = 25°C			SN54ABT651		SN74ABT651		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f _{max}			125			125		125		MHz
t _{PLH}	CLKBA or CLKAB	A or B	2.2	4	5.1	2.2	5.9	2.2	5.6	ns
t _{PHL}			1.7	4	5.1	1.7	5.9	1.7	5.6	
t _{PLH}	A or B	B or A	1.5	4	5.1	1.5	6.4	1.5	6.2	ns
t _{PHL}			1.5	3.3	4.6	1.5	5.6	1.5	5.4	
t _{PLH}	SAB or SBA†	A or B	1.5	4	5.1	1.5	6.8	1.5	6.5	ns
t _{PHL}			1.5	3.6	4.9	1.5	6.2	1.5	5.9	
t _{PZH}	$\overline{\text{OEBA}}$	A	1.3	3.6	4.6	1.3	5.9	1.3	5.8	ns
t _{PZL}			2.5	5.7	6.8	2.5	8.9	2.5	8.5	
t _{PHZ}	$\overline{\text{OEBA}}$	A	1.5	3.2	4.5	1.5	6.2	1.5	5	ns
t _{PLZ}			1.5	3	3.8	1.5	4.3	1.5	4.1	
t _{PZH}	OEAB	B	1.8	4.3	6.1	1.8	6.7	1.8	6.5	ns
t _{PZL}			2.9	5.5	6.5	2.9	7.6	2.9	7.4	
t _{PHZ}	OEAB	B	1.5	3.3	4.5	1.5	6.5	1.5	5.5	ns
t _{PLZ}			1.5	3.4	4.4	1.5	5.2	1.5	5.1	

† These parameters are measured with the internal output state of the storage register opposite to that of the bus input.

SN54ABT651, SN74ABT651 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

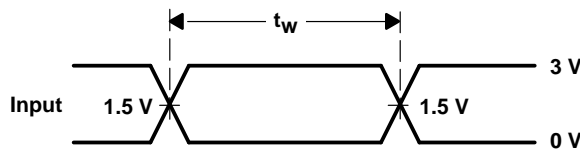
SCBS083C – JANUARY 1991 – REVISED JULY 1994

PARAMETER MEASUREMENT INFORMATION

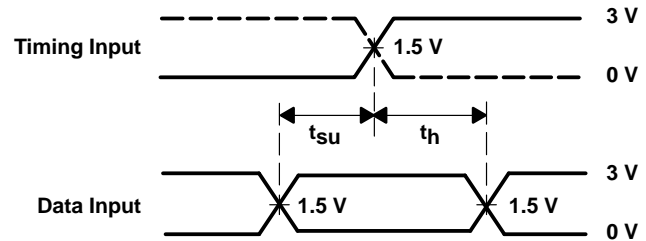


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open

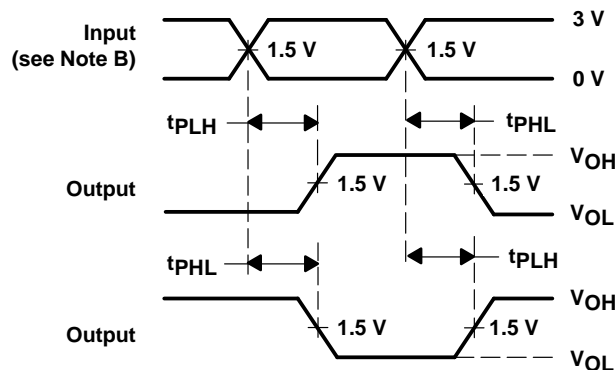
LOAD CIRCUIT FOR OUTPUTS



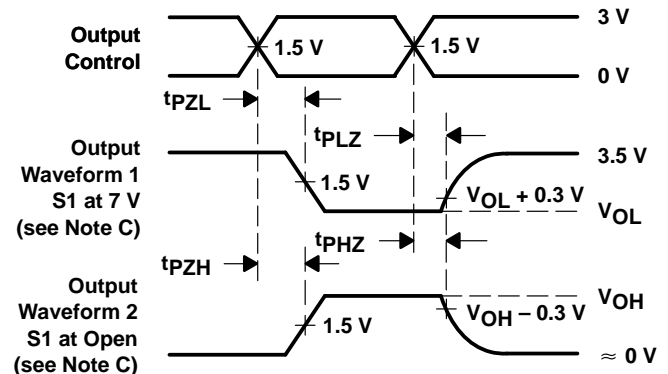
VOLTAGE WAVEFORMS
PULSE DURATION



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:
- C_L includes probe and jig capacitance.
 - All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
 - 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.
 - The outputs are measured one at a time with one transition per measurement.

Figure 2. Load Circuit and Voltage Waveforms

IMPORTANT NOTICE

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

TI warrants performance of its semiconductor products and related software to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Certain applications using semiconductor products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications").

TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS.

Inclusion of TI products in such applications is understood to be fully at the risk of the customer. Use of TI products in such applications requires the written approval of an appropriate TI officer. Questions concerning potential risk applications should be directed to TI through a local SC sales office.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TI warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.