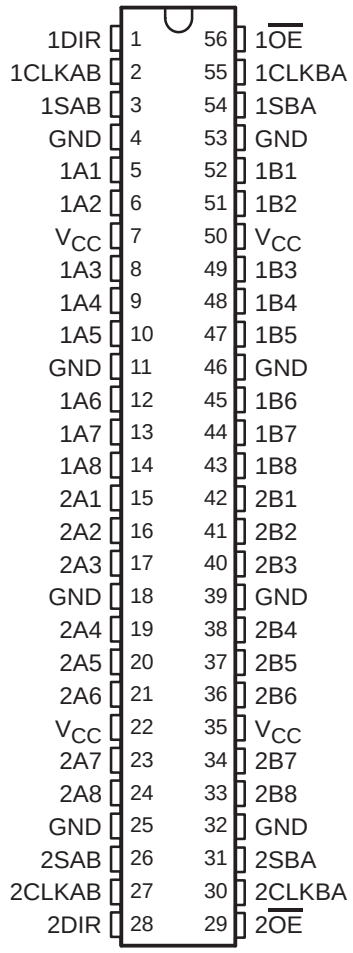
- **Members of the Texas Instruments *Widebus*™ Family**
- **State-of-the-Art *EPIC*-II*B*™ BiCMOS Design Significantly Reduces Power Dissipation**
- **Latch-Up Performance Exceeds 500 mA Per JESD 17**
- **Typical V_{OLP} (Output Ground Bounce) < 1 V at V_{CC} = 5 V, T_A = 25°C**
- **Distributed V_{CC} 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})**
- **Package Options Include Plastic Shrink Small-Outline (DL), Thin Shrink Small-Outline (DGG) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings**

SN54ABT16646 . . . WD PACKAGE
SN74ABT16646 . . . DGG OR DL PACKAGE
(TOP VIEW)



description

The ’ABT16646 devices consist of bus-transceiver circuits, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from the internal registers.

These devices can be used as two 8-bit transceivers or one 16-bit transceiver. Data on the A or B bus is clocked into the registers on the low-to-high transition of the appropriate clock (CLKAB or CLKBA) input. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the ’ABT16646 devices.

Output-enable ($\overline{OE}$) and direction-control (DIR) inputs are provided to control the transceiver functions. In the transceiver mode, data present at the high-impedance port may be stored in either register or in both. The select-control (SAB and SBA) inputs can multiplex stored and real-time (transparent mode) data. The circuitry used for select control eliminates the typical decoding glitch that occurs in a multiplexer during the transition between stored and real-time data. The direction control (DIR) determines which bus receives data when $\overline{OE}$ is low. In the isolation mode ($\overline{OE}$ high), A data can be stored in one register and/or B data can be stored in the other register.

When an output function is disabled, the input function is still enabled and can be used to store and transmit data. Only one of the two buses, A or B, can be driven at a time.

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.

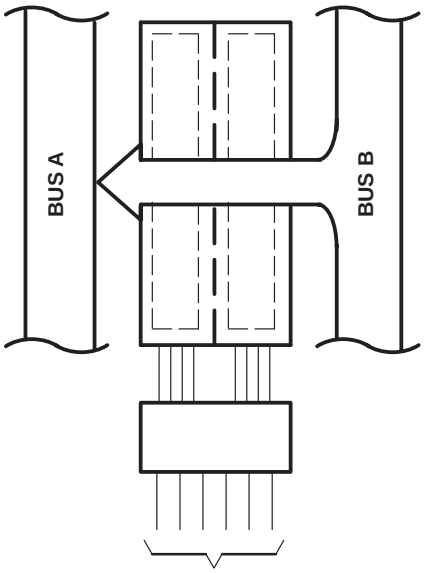
description (continued)

The SN54ABT16646 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74ABT16646 is characterized for operation from –40°C to 85°C.

FUNCTION TABLE

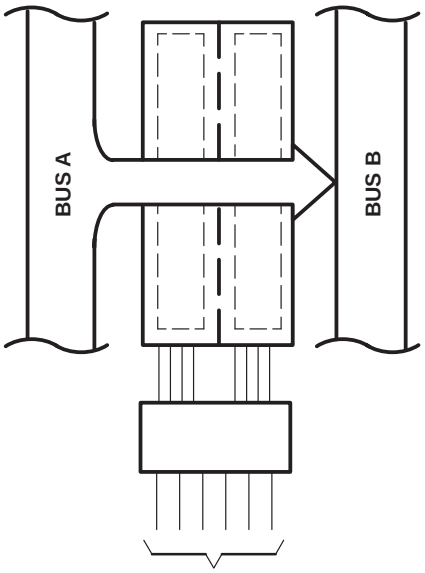
INPUTS						DATA I/O†		OPERATION OR FUNCTION
$\overline{OE}$	DIR	CLKAB	CLKBA	SAB	SBA	A1–A8	B1–B8	
X	X	↑	X	X	X	Input	Unspecified	Store A, B unspecified†
X	X	X	↑	X	X	Unspecified	Input	Store B, A unspecified†
H	X	↑	↑	X	X	Input	Input	Store A and B data
H	X	H or L	H or L	X	X	Input disabled	Input disabled	Isolation, hold storage
L	L	X	X	X	L	Output	Input	Real-time B data to A bus
L	L	X	H or L	X	H	Output	Input	Stored B data to A bus
L	H	X	X	L	X	Input	Output	Real-time A data to B Bus
L	H	H or L	X	H	X	Input	Output	Stored A data to bus

† The data-output functions can be enabled or disabled by various signals at $\overline{OE}$ or DIR. Data-input functions always are enabled, i.e., data at the bus terminals is stored on every low-to-high transition of the clock inputs.



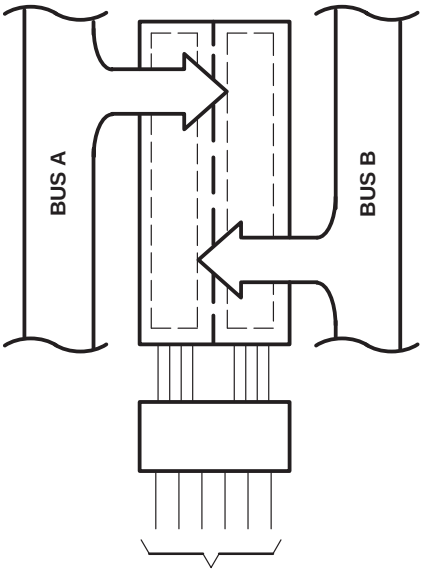
$\overline{OE}$	DIR	CLKAB	CLKBA	SAB	SBA
L	L	X	X	X	L

REAL-TIME TRANSFER
BUS B TO BUS A



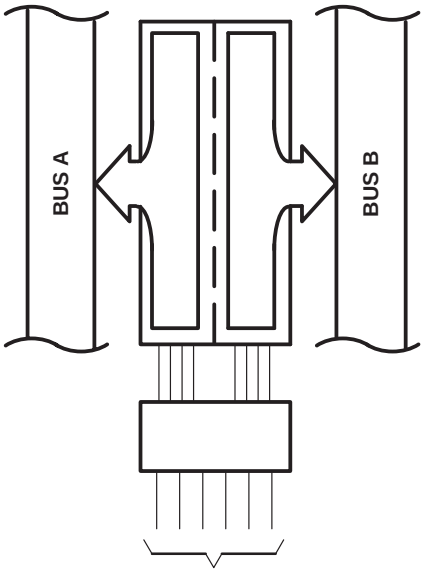
$\overline{OE}$	DIR	CLKAB	CLKBA	SAB	SBA
L	H	X	X	L	X

REAL-TIME TRANSFER
BUS A TO BUS B



$\overline{OE}$	DIR	CLKAB	CLKBA	SAB	SBA
X	X	↑	X	X	X
X	X	X	↑	X	X
H	X	↑	↑	X	X

STORAGE FROM
A, B, OR A AND B

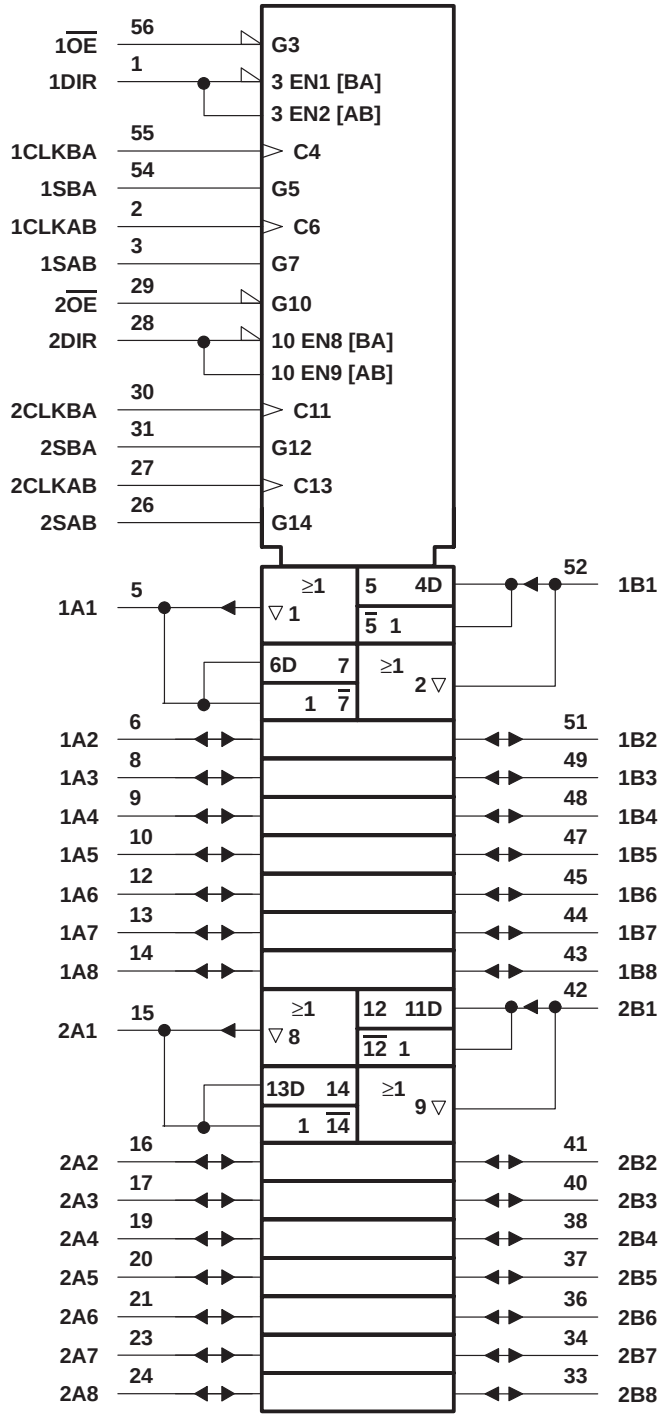


$\overline{OE}$	DIR	CLKAB	CLKBA	SAB	SBA
L	L	X	H or L	X	H
L	H	H or L	X	H	X

TRANSFER STORED DATA
TO A AND/OR B

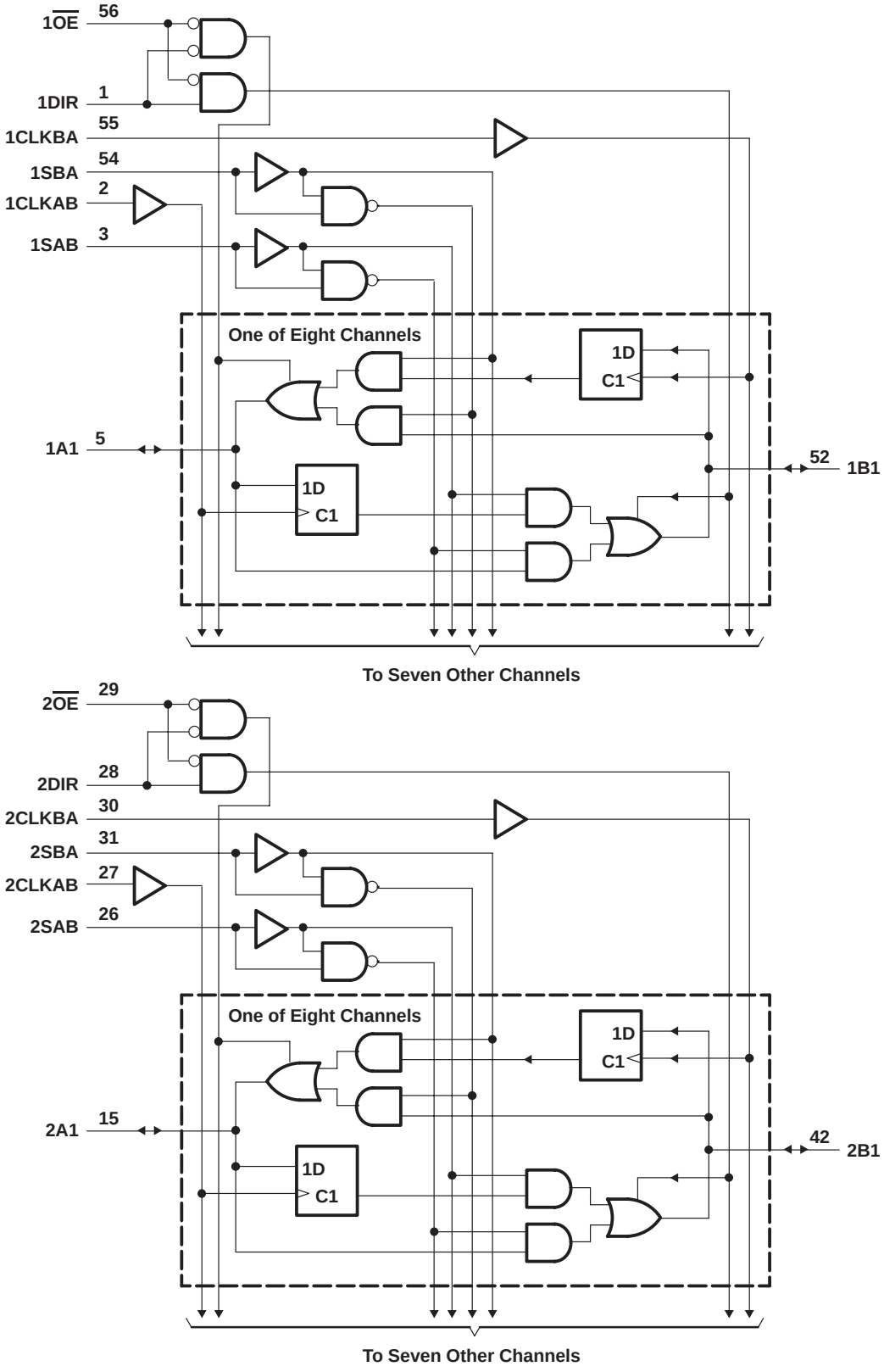
Figure 1. Bus-Management Functions

logic symbol†



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

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_O: SN54ABT16646 . . . . . 96 mA
SN74ABT16646 . . . . . 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 JESD 51.

recommended operating conditions (see Note 3)

			SN54ABT16646		SN74ABT16646		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
T_A	Operating free-air temperature		–55	125	–40	85	°C

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

PARAMETER		TEST CONDITIONS		T_A = 25°C			SN54ABT16646		SN74ABT16646		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		±20		±20	
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_{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_{CC}	A or B ports	V_{CC} = 5.5 V, I_O = 0, V_I = V_{CC} or GND	Outputs high			2		2		2	mA
			Outputs low			32		32		32	
			Outputs disabled			2		2		2	
ΔI_{CC}¶	Data inputs	V_{CC} = 5.5 V, One input at 3.4 V, Other inputs at V_{CC} or GND	Outputs enabled			50		50		50	µA
			Outputs disabled			50		50		50	
	Control inputs	V_{CC} = 5.5 V, One input at 3.4 V, Other inputs at V_{CC} or GND				50		50		50	
C_i	Control inputs	V_I = 2.5 V or 0.5 V			4						pF
C_{io}	A or B ports	V_O = 2.5 V or 0.5 V			8						pF

* On products compliant to MIL-PRF-38535, this parameter does not apply.
† All typical values are at V_{CC} = 5 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.

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

		SN54ABT16646				UNIT
		V_{CC} = 5 V, T_A = 25°C		MIN	MAX	
		MIN	MAX			
f_{clock}	Clock frequency		125		125	MHz
t_w	Pulse duration, CLK high or low	4.3		4.3		ns
t_{su}	Setup time, A or B before CLKAB↑ or CLKBA↑	3.5		4		ns
t_h	Hold time, A or B after CLKAB↑ or CLKBA↑	0.5		0.5		ns

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

		SN74ABT16646				UNIT
		V_{CC} = 5 V, T_A = 25°C		MIN	MAX	
		MIN	MAX			
f_{clock}	Clock frequency		125		125	MHz
t_w	Pulse duration, CLK high or low	4.3		4.3		ns
t_{su}	Setup time, A or B before CLKAB↑ or CLKBA↑	3		3		ns
t_h	Hold time, A or B after CLKAB↑ or CLKBA↑	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)	SN54ABT16646					UNIT
			V_{CC} = 5 V, T_A = 25°C			MIN	MAX	
			MIN	TYP	MAX			
f_{max}			125			125		MHz
t_{PLH}	CLKBA or CLKAB	A or B	1.5	3.1	4	1	5	ns
t_{PHL}			1.5	3.2	4.1	1	5	
t_{PLH}	A or B	B or A	1	2.3	3.2	0.6	4	ns
t_{PHL}			1	3	4.1	0.6	4.9	
t_{PLH}	SAB or SBA†	B or A	1	2.9	4.3	0.6	5.3	ns
t_{PHL}			1	3.1	4.3	0.6	5.3	
t_{PZH}	$\overline{OE}$	A or B	1	3.4	4.6	0.6	5.9	ns
t_{PZL}			1.5	3.5	5.3	1	6	
t_{PHZ}	$\overline{OE}$	A or B	1.5	3.9	5.6	1	6.4	ns
t_{PLZ}			1.5	3.1	4.4	1	4.7	
t_{PZH}	DIR	A or B	1	3.2	4.5	0.6	5.8	ns
t_{PZL}			1.5	3.4	5.1	1	6.7	
t_{PHZ}	DIR	A or B	2	4.2	5.9	1.2	7.1	ns
t_{PLZ}			1.5	3.6	5.1	1	6.2	

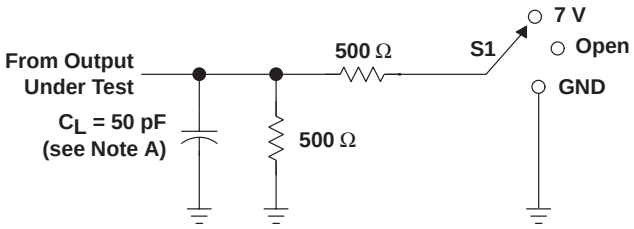
† These parameters are measured with the internal output state of the storage register opposite that of the bus input.

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)	SN74ABT16646					UNIT
			V_{CC} = 5 V, T_A = 25°C			MIN	MAX	
			MIN	TYP	MAX			
f_{max}			125			125		MHz
t_{PLH}	CLKBA or CLKAB	A or B	1.5	3.1	4	1.5	4.9	ns
t_{PHL}			1.5	3.2	4.1	1.5	4.7	
t_{PLH}	A or B	B or A	1	2.3	3.2	1	3.9	ns
t_{PHL}			1	3	4.1	1	4.6	
t_{PLH}	SAB or SBA†	B or A	1	2.9	4.3	1	5	ns
t_{PHL}			1	3.1	4.3	1	5	
t_{PZH}	$\overline{OE}$	A or B	1	3.4	4.6	1	5.5	ns
t_{PZL}			1.5	3.5	4.9	1.5	5.7	
t_{PHZ}	$\overline{OE}$	A or B	1.5	3.9	4.9	1.5	5.4	ns
t_{PLZ}			1.5	3.1	4.1	1.5	4.5	
t_{PZH}	DIR	A or B	1	3.2	4.5	1	5.4	ns
t_{PZL}			1.5	3.4	4.8	1.5	5.6	
t_{PHZ}	DIR	A or B	2	4.2	5.7	2	6.7	ns
t_{PLZ}			1.5	3.6	5.1	1.5	5.9	

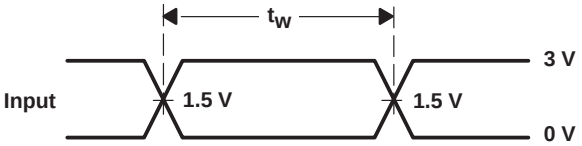
† These parameters are measured with the internal output state of the storage register opposite that of the bus input.

PARAMETER MEASUREMENT INFORMATION

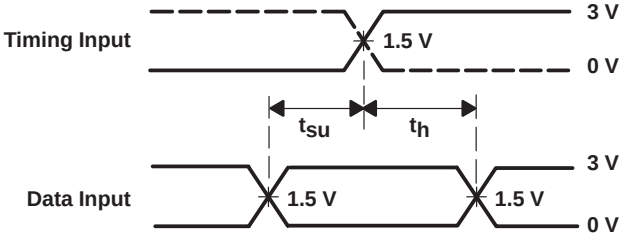


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open

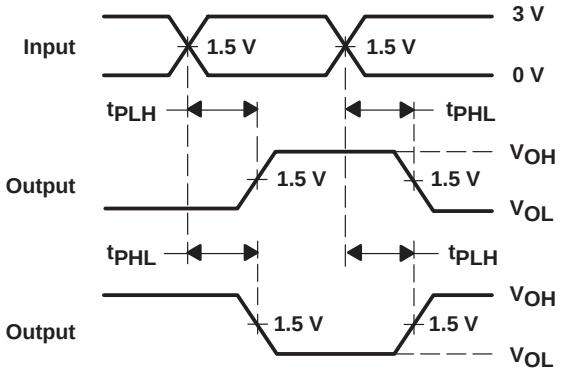
LOAD CIRCUIT



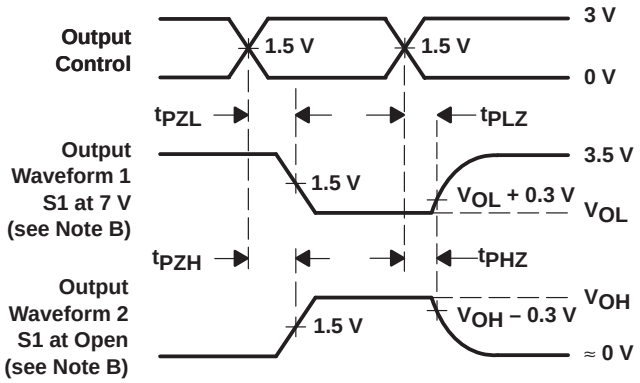
VOLTAGE WAVEFORMS
PULSE DURATION



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 2. Load Circuit and Voltage Waveforms

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SN54ABT16646, 16-Bit Bus Transceivers And Registers With 3-State Outputs

DEVICE STATUS: **ACTIVE**

PARAMETER NAME	SN54ABT16646	SN74ABT16646
Voltage Nodes (V)	5	5
Vcc range (V)	4.5 to 5.5	4.5 to 5.5
Input Level	TTL	TTL
Output Level	TTL	TTL
No. of Outputs	16	16
Static Current		17

FEATURES

Back to Top

- 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 JESD 17
- Typical V_{OLP} (Output Ground Bounce) < 1 V at V_{CC} = 5 V, T_A = 25°C
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- Package Options Include Plastic Shrink Small-Outline (DL), Thin Shrink Small-Outline (DGG) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings

DESCRIPTION

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The 'ABT16646 devices consist of bus-transceiver circuits, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from the internal registers.

These devices can be used as two 8-bit transceivers or one 16-bit transceiver. Data on the A or B bus is clocked into the registers on the low-to-high transition of the appropriate clock (CLKAB or CLKBA) input. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the 'ABT16646 devices.

Output-enable (OE\) and direction-control (DIR) inputs are provided to control the transceiver functions. In the transceiver mode, data present at the high-impedance port may be stored in either register or in both. The select-control (SAB and SBA) inputs can multiplex stored and real-time (transparent mode) data. The circuitry used for select control eliminates the typical decoding glitch that occurs in a multiplexer during the transition between stored and real-time data. The direction control (DIR) determines which bus receives data when OE\ is low. In the isolation mode (OE\ high), A data can be stored in one register and/or B data can be stored in the other register.

When an output function is disabled, the input function is still enabled and can be used to store and transmit data. Only one of the two buses, A or B, can be driven at a time.

To ensure the high-impedance state during power up or power down, 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.

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TECHNICAL DOCUMENTS

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To view the following documents, Acrobat Reader 4.0 is required.

Product Folder: SN54ABT16646, 16-Bit Bus Transceivers And Registers With 3-State Outputs

To download a document to your hard drive, right-click on the link and choose 'Save'.

DATASHEET

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Full datasheet in Acrobat PDF: sn54abt16646.pdf (158 KB,Rev.D) (Updated: 07/29/1999)

APPLICATION NOTES

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View Application Notes for Digital Logic

- Advanced BiCMOS Technology (ABT) Logic Characterization Information (Rev. B) (SCBA008B - Updated: 06/01/1997)
- Advanced BiCMOS Technology (ABT) Logic Enables Optimal System Design (Rev. A) (SCBA001A - Updated: 03/01/1997)
- Bus-Interface Devices With Output-Damping Resistors Or Reduced-Drive Outputs (Rev. A) (SCBA012A - Updated: 08/01/1997)
- Designing With Logic (Rev. C) (SDYA009C - Updated: 06/01/1997)
- Evaluation of Nickel/Palladium/Gold-Finished Surface-Mount Integrated Circuits (SZZA026 - Updated: 06/20/2001)
- Family of Curves Demonstrating Output Skews for Advanced BiCMOS Devices (Rev. A) (SCBA006A - Updated: 12/01/1996)
- Implications of Slow or Floating CMOS Inputs (Rev. C) (SCBA004C - Updated: 02/01/1998)
- Input and Output Characteristics of Digital Integrated Circuits (SDYA010 - Updated: 10/01/1996)
- Live Insertion (SDYA012 - Updated: 10/01/1996)
- Power-Up 3-State (PU3S) Circuits in TI Standard Logic Devices (SZZA033 - Updated: 05/10/2002)
- Quad Flatpack No-Lead Logic Packages (Rev. C) (SCBA017C - Updated: 11/22/2002)
- TI IBIS File Creation, Validation, and Distribution Processes (SZZA034 - Updated: 08/29/2002)
- Understanding Advanced Bus-Interface Products Design Guide (SCAA029, 253 KB - Updated: 05/01/1996)
- Understanding and Interpreting Texas Instruments Standard-Logic Products Data Sh (Rev. A) (SZZA036A - Updated: 02/27/2003)

MORE LITERATURE

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- Enhanced Plastic Portfolio Brochure (SGZB004, 387 KB - Updated: 08/19/2002)
- Logic Reference Guide (SCYB004, 1032 KB - Updated: 10/23/2001)
- MicroStar Junior BGA Design Summary (SCET004, 167 KB - Updated: 07/28/2000)
- Military Brief (SGYN138, 803 KB - Updated: 10/10/2000)
- Overview of IEEE Std 91-1984, Explanation of Logic Symbols Training Booklet (Rev. A) (SDYZ001A, 138 KB - Updated: 07/01/1996)
- Palladium Lead Finish User's Manual (SDYV001, 2041 KB - Updated: 11/01/1996)
- QML Class V Space Products Military Brief (Rev. A) (SGZN001A, 257 KB - Updated: 10/07/2002)

USER GUIDES

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- LOGIC Pocket Data Book (SCYD013, 4837 KB - Updated: 12/05/2002)

BLOCK DIAGRAMS

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- Electro-Optics
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- Target Detection Recognition

PRICING/AVAILABILITY/PKG

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DEVICE INFORMATION
Updated Daily

ORDERABLE DEVICE	STATUS	PACKAGE TYPE | PINS	TEMP (°C)	DSCC NUMBER	PRODUCT CONTENT	BUDGETARY PRICING QTY | $US	STD PACK QTY
5962-9450201QXA	ACTIVE	CFP (WD) | 56	-55 TO 125		View Contents	1KU | 24.14	1

TI INVENTORY STATUS
As Of 09:00 AM GMT, 17 Apr 2003

IN STOCK	IN PROGRESS QTY | DATE	LEAD TIME
58*	8 | 14 May	8 WKS
	>10k | 20 May	

REPORTED DISTRIBUTOR INVENTORY
As Of 09:00 AM GMT, 17 Apr 2003

DISTRIBUTOR COMPANY | REGION	IN STOCK	PURCHASE
None Reported View Distributors		

Product Folder: SN54ABT16646, 16-Bit Bus Transceivers And Registers With 3-State Outputs

SNJ54ABT16646WD	ACTIVE	CFP (WD)	56	-55 TO 125	5962-9450201QXA	View Contents	1KU | 24.14	1	0*	>10k | 20 May	8 WKS	None Reported View Distributors		

Table Data Updated on: 4/17/2003