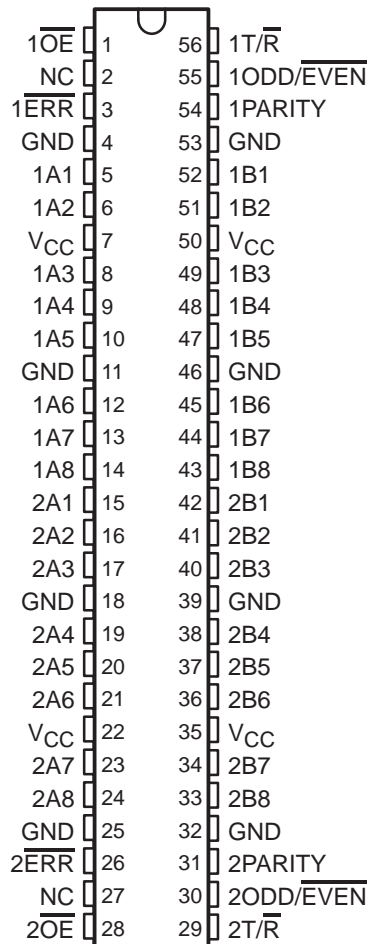


# SN54ABT16657, SN74ABT16657 16-BIT TRANSCEIVERS WITH PARITY GENERATORS/CHECKERS AND 3-STATE OUTPUTS

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- **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  $V_{CC} = 5 V, T_A = 25^\circ C$**
- **Distributed  $V_{CC}$  and GND Pin Configuration Minimizes High-Speed Switching Noise**
- **Flow-Through Architecture Optimizes PCB Layout**
- **High-Drive Outputs ( $-32\text{-mA } I_{OH}, 64\text{-mA } I_{OL}$ )**
- **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**

SN54ABT16657 . . . WD PACKAGE  
SN74ABT16657 . . . DGG OR DL PACKAGE  
(TOP VIEW)



NC – No internal connection

## description

The 'ABT16657 contain two noninverting octal transceiver sections with separate parity generator/checker circuits and control signals. For either section, the transmit/receive ( $1T/\bar{R}$  or  $2T/\bar{R}$ ) input determines the direction of data flow. When  $1T/\bar{R}$  (or  $2T/\bar{R}$ ) is high, data flows from the 1A (or 2A) port to the 1B (or 2B) port (transmit mode); when  $1T/\bar{R}$  (or  $2T/\bar{R}$ ) is low, data flows from the 1B (or 2B) port to the 1A (or 2A) port (receive mode). When the output-enable ( $1OE$  or  $2OE$ ) input is high, both the 1A (or 2A) and 1B (or 2B) ports are in the high-impedance state.

Odd or even parity is selected by a logic high or low level, respectively, on the  $1ODD/\overline{EVEN}$  (or  $2ODD/\overline{EVEN}$ ) input.  $1PARITY$  (or  $2PARITY$ ) carries the parity bit value; it is an output from the parity generator/checker in the transmit mode and an input to the parity generator/checker in the receive mode.

In the transmit mode, after the 1A (or 2A) bus is polled to determine the number of high bits,  $1PARITY$  (or  $2PARITY$ ) is set to the logic level that maintains the parity sense selected by the level at the  $1ODD/\overline{EVEN}$  (or  $2ODD/\overline{EVEN}$ ) input. For example, if  $1ODD/\overline{EVEN}$  is low (even parity selected) and there are five high bits on the 1A bus, then  $1PARITY$  is set to the logic high level so that an even number of the nine total bits (eight 1A-bus bits plus parity bit) are high.



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**TEXAS  
INSTRUMENTS**

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# SN54ABT16657, SN74ABT16657 16-BIT TRANSCEIVERS WITH PARITY GENERATORS/CHECKERS AND 3-STATE OUTPUTS

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## description (continued)

In the receive mode, after the 1B (or 2B) bus is polled to determine the number of high bits, the  $1\overline{ERR}$  (or  $2\overline{ERR}$ ) output logic level indicates whether or not the data to be received exhibits the correct parity sense. For example, if  $1\text{ODD}/\overline{\text{EVEN}}$  is high (odd parity selected),  $1\text{PARITY}$  is high, and there are three high bits on the 1B bus, then  $1\overline{ERR}$  is low, indicating a parity error.

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 SN54ABT16657 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ABT16657 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

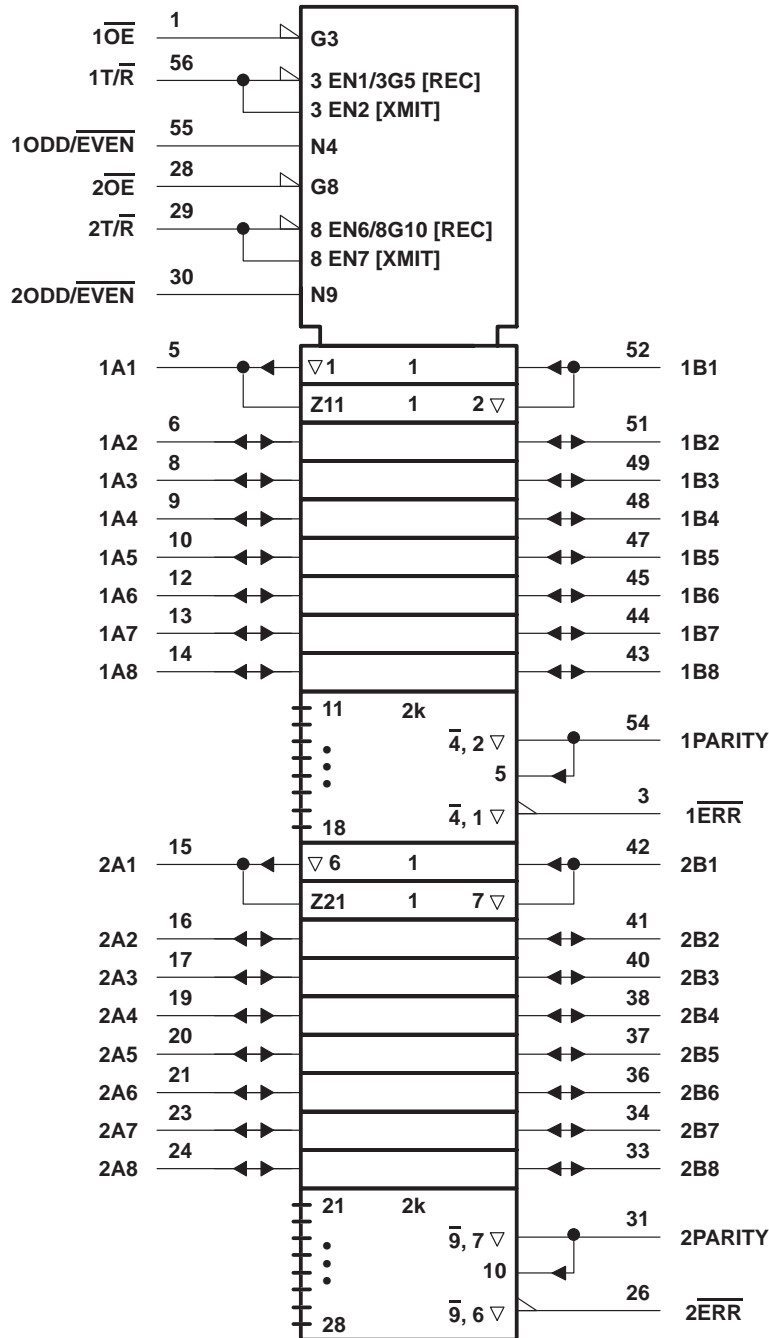
FUNCTION TABLE  
(each 8-bit section)

NUMBER OF A OR B INPUTS THAT ARE HIGH	INPUTS			INPUT/OUTPUT PARITY	OUTPUTS	
	$\overline{OE}$	$\text{T}/\overline{\text{R}}$	$\text{ODD}/\overline{\text{EVEN}}$		$\overline{\text{ERR}}$	OUTPUT MODE
0, 2, 4, 6, 8	L	H	H	H	Z	Transmit
	L	H	L	L	Z	Transmit
	L	L	H	H	H	Receive
	L	L	H	L	L	Receive
	L	L	L	H	L	Receive
	L	L	L	L	L	Receive
1, 3, 5, 7	L	H	H	L	Z	Transmit
	L	H	L	H	Z	Transmit
	L	L	H	H	L	Receive
	L	L	H	L	H	Receive
	L	L	L	H	H	Receive
	L	L	L	L	L	Receive
Don't care	H	X	X	Z	Z	Z

# SN54ABT16657, SN74ABT16657 16-BIT TRANSCEIVERS WITH PARITY GENERATORS/CHECKERS AND 3-STATE OUTPUTS

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logic symbol†

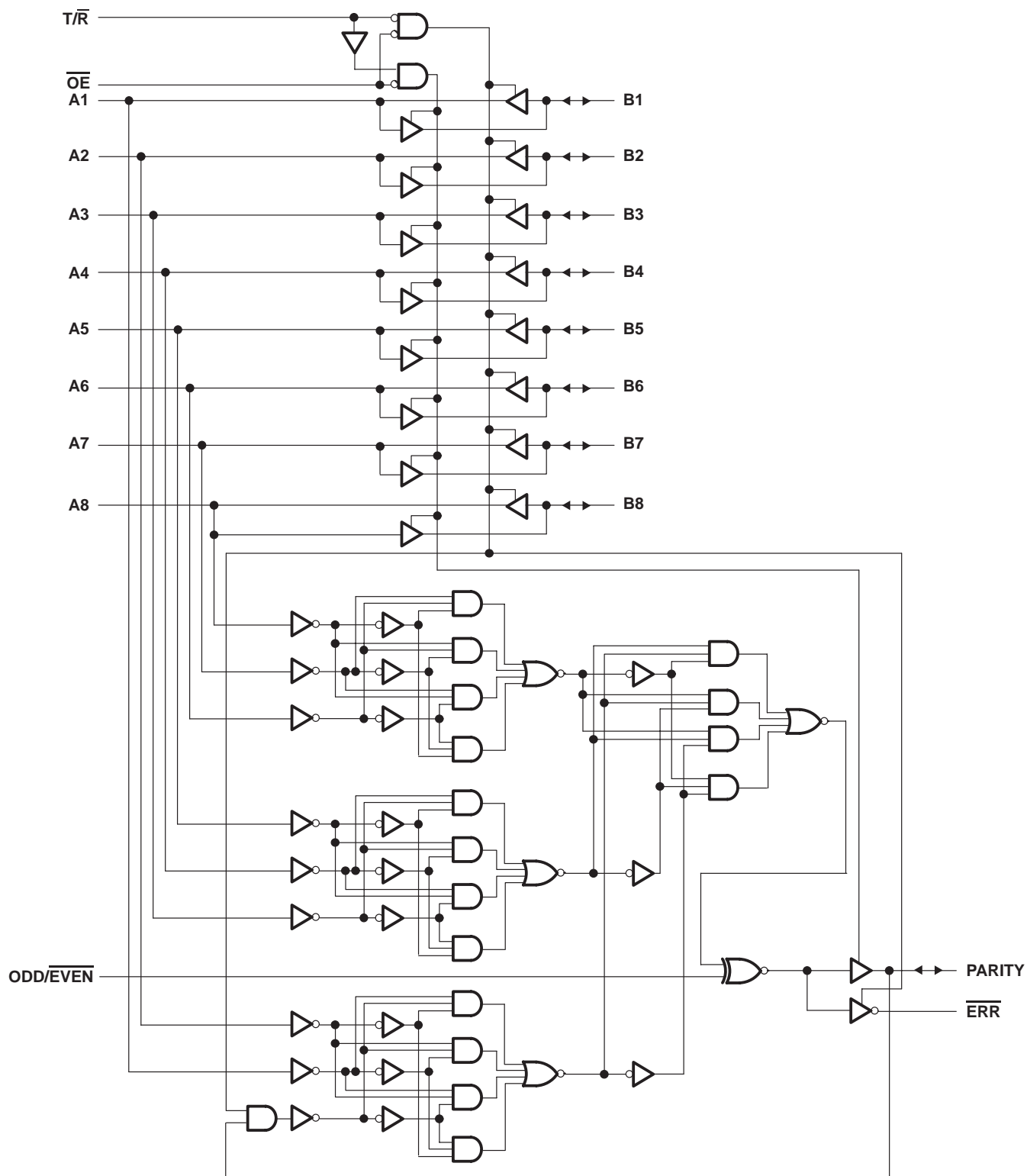


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

# SN54ABT16657, SN74ABT16657 16-BIT TRANSCEIVERS WITH PARITY GENERATORS/CHECKERS AND 3-STATE OUTPUTS

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## logic diagram (positive logic)



# SN54ABT16657, SN74ABT16657 16-BIT TRANSCEIVERS WITH PARITY GENERATORS/CHECKERS AND 3-STATE OUTPUTS

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## 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, $I_O$ : SN54ABT16657 .....	96 mA
SN74ABT16657 .....	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, $\theta_{JA}$ (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.

## recommended operating conditions (see Note 3)

		SN54ABT16657		SN74ABT16657		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	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.

# SN54ABT16657, SN74ABT16657 16-BIT TRANSCEIVERS WITH PARITY GENERATORS/CHECKERS AND 3-STATE OUTPUTS

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

PARAMETER	TEST CONDITIONS	T <sub>A</sub> = 25°C			SN54ABT16657		SN74ABT16657		UNIT	
		MIN	TYP†	MAX	MIN	MAX	MIN	MAX		
V <sub>IK</sub>	V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA			-1.2		-1.2		-1.2	V	
V <sub>OH</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -3 mA			2.5		2.5		2.5	V	
	V <sub>CC</sub> = 5 V, I <sub>OH</sub> = -3 mA			3		3		3		
	V <sub>CC</sub> = 4.5 V	I <sub>OH</sub> = -24 mA			2		2			
I <sub>OH</sub> = -32 mA				2*				2		
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V	I <sub>OL</sub> = 24 mA				0.55		0.55	V	
		I <sub>OL</sub> = 64 mA				0.55*		0.55		
V <sub>hys</sub>				100					mV	
I <sub>I</sub>	Control inputs	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND			±1		±1		±1	μA
	A or B ports				±100		±100		±100	
I <sub>OZH</sub> ‡	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.7 V			50		50		50	μA	
I <sub>OZL</sub> ‡	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0.5 V			-50		-50		-50	μA	
I <sub>off</sub>	V <sub>CC</sub> = 0, V <sub>I</sub> or V <sub>O</sub> ≤ 4.5 V			±100		±450		±100	μA	
I <sub>CEX</sub>	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 5.5 V	Outputs high				50		50	μA	
I <sub>O</sub> §	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.5 V			-50	-100	-180		-50	-180	mA
I <sub>CC</sub>	A or B ports	V <sub>CC</sub> = 5.5 V, I <sub>O</sub> = 0, V <sub>I</sub> = V <sub>CC</sub> or GND	Outputs high			2		2	2	mA
			Outputs low			36		36	36	
			Outputs disabled			2		2	2	
ΔI <sub>CC</sub> ¶		V <sub>CC</sub> = 5.5 V, One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND			50		50		50	μA
C <sub>i</sub>	Control inputs	V <sub>I</sub> = 2.5 V or 0.5 V			3					pF
C <sub>iO</sub>	A or B ports	V <sub>O</sub> = 2.5 V or 0.5 V			9					pF

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

† All typical values are at V<sub>CC</sub> = 5 V.

‡ The parameters I<sub>OZH</sub> and I<sub>OZL</sub> 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<sub>CC</sub> or GND.

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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)	$V_{CC} = 5$ V, $T_A = 25^\circ$ C			SN54ABT16657		SN74ABT16657		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{PLH}$	A or B	B or A	1.5	2.5	3.3	1.5	4.2	1.5	4.1	ns
$t_{PHL}$			2	3.1	3.9	2	4.5	2	4.3	
$t_{PLH}$	A	PARITY	2	4.6	5.4	2	7	2	6.7	ns
$t_{PHL}$			2	4.3	5.1	2	6.5	2	6.1	
$t_{PLH}$	ODD/EVEN	PARITY, $\overline{ERR}$	2	4.6	5.4	2	7	2	6.7	ns
$t_{PHL}$			2	4.3	5.1	2	6.5	2	6.1	
$t_{PLH}$	B	$\overline{ERR}$	2	4.6	5.4	2	7	2	6.7	ns
$t_{PHL}$			2	4.3	5.1	2	6.5	2	6.1	
$t_{PLH}$	PARITY	$\overline{ERR}$	2	4.6	5.4	2	7	2	6.7	ns
$t_{PHL}$			2	4.3	5.1	2	6.5	2	6.1	
$t_{PZH}$	$\overline{OE}$	A or B	2	3.9	4.9	2	5.8	2	5.6	ns
$t_{PZL}$			2.5	4.3	5.1	2.5	6.2	2.5	6	
$t_{PHZ}$	$\overline{OE}$	A or B	2	3.6	4.5	2	5.5	2	5.4	ns
$t_{PLZ}$			1.5	3	3.8	1.5	4.7	1.5	4.3	
$t_{PZH}$	$\overline{OE}$	PARITY, $\overline{ERR}$	2	4	4.9	2	5.8	2	5.6	ns
$t_{PZL}$			2.5	4.1	5.1	2.5	6.2	2.5	6	
$t_{PHZ}$	$\overline{OE}$	PARITY, $\overline{ERR}$	1	3.5	4.5	1	5.5	1	5.4	ns
$t_{PLZ}$			1.5	3	3.8	1.5	4.7	1.5	4.3	

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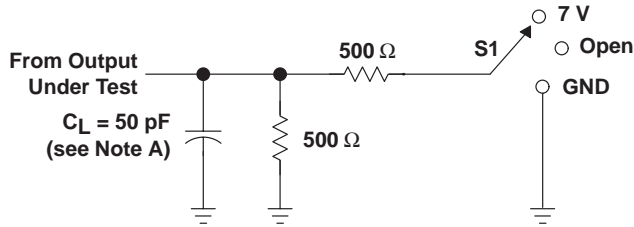


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# SN54ABT16657, SN74ABT16657 16-BIT TRANSCEIVERS WITH PARITY GENERATORS/CHECKERS AND 3-STATE OUTPUTS

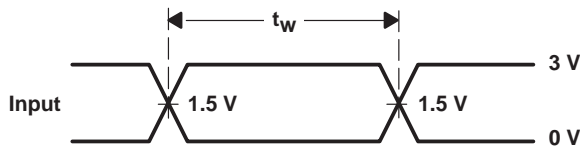
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## PARAMETER MEASUREMENT INFORMATION

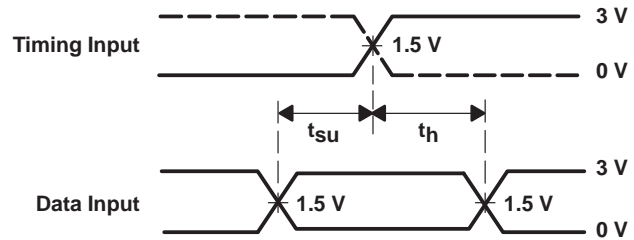


TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	7 V
$t_{PHZ}/t_{PZH}$	Open

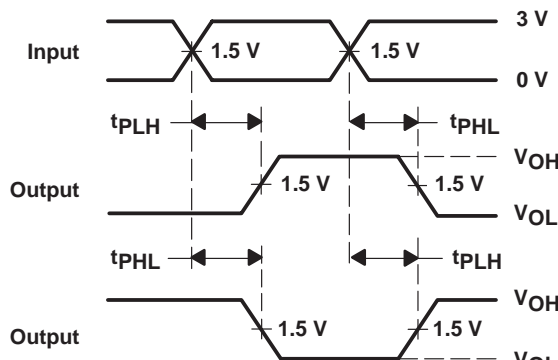
LOAD CIRCUIT



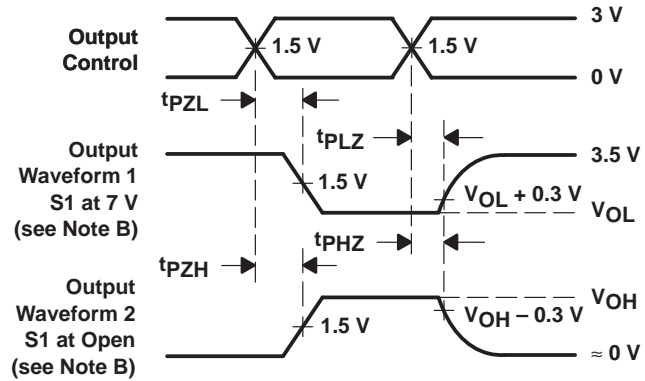
VOLTAGE WAVEFORMS  
PULSE DURATION



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

Figure 1. Load Circuit and Voltage Waveforms



**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
74ABT16657DGGRE4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ABT16657DGGRG4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16657DGGR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16657DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16657DLG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16657DLR	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16657DLRG4	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

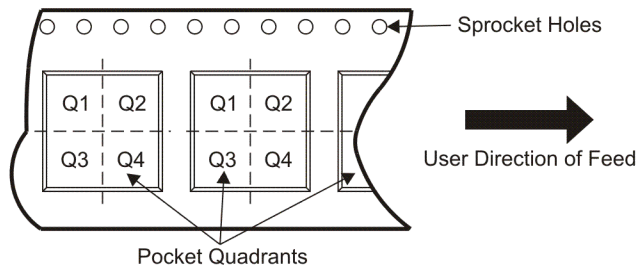
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**TAPE AND REEL INFORMATION**



**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74ABT16657DGGR	TSSOP	DGG	56	2000	330.0	24.4	8.6	15.6	1.8	12.0	24.0	Q1
SN74ABT16657DLR	SSOP	DL	56	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1

**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ABT16657DGGR	TSSOP	DGG	56	2000	346.0	346.0	41.0
SN74ABT16657DLR	SSOP	DL	56	1000	346.0	346.0	49.0

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