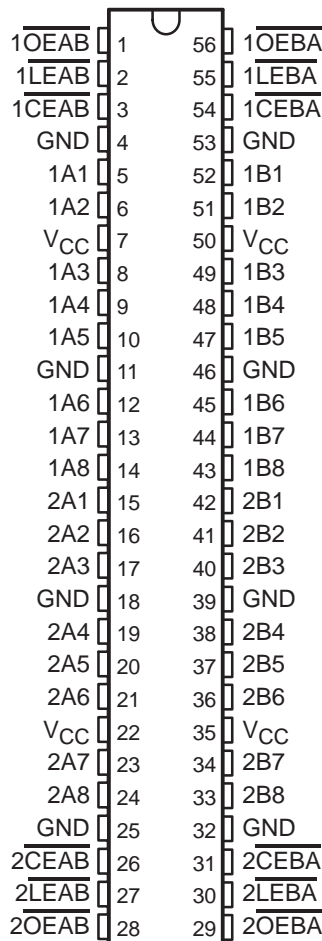


# SN54ABT16543, SN74ABT16543 16-BIT REGISTERED TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS087C – FEBRUARY 1991 – REVISED JANUARY 1997

- 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,  $T_A = 25^\circ\text{C}$
- 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 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

SN54ABT16543 . . . WD PACKAGE  
SN74ABT16543 . . . DGG OR DL PACKAGE  
(TOP VIEW)



## description

The 'ABT16543 16-bit registered transceivers contain two sets of D-type latches for temporary storage of data flowing in either direction. The 'ABT16543 can be used as two 8-bit transceivers or one 16-bit transceiver. Separate latch-enable ( $\overline{LEAB}$  or  $\overline{LEBA}$ ) and output-enable ( $\overline{OEAB}$  or  $\overline{OEBA}$ ) inputs are provided for each register to permit independent control in either direction of data flow.

The A-to-B enable ( $\overline{CEAB}$ ) input must be low to enter data from A to output data from B. If  $\overline{CEAB}$  is low and  $\overline{LEAB}$  is low, the A-to-B latches are transparent; a subsequent low-to-high transition of  $\overline{LEAB}$  puts the A latches in the storage mode. With  $\overline{CEAB}$  and  $\overline{OEAB}$  both low, the 3-state B outputs are active and reflect the data present at the output of the A latches. Data flow from B to A is similar but requires using the  $\overline{CEBA}$ ,  $\overline{LEBA}$ , and  $\overline{OEBA}$  inputs.

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 SN54ABT16543 is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ . The SN74ABT16543 is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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PRODUCTION DATA information is 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  
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**SN54ABT16543, SN74ABT16543**  
**16-BIT REGISTERED TRANSCEIVERS**  
**WITH 3-STATE OUTPUTS**

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**FUNCTION TABLE†**  
 (each 8-bit section)

INPUTS				OUTPUT B
$\overline{CEAB}$	$\overline{LEAB}$	$\overline{OEAB}$	A	
H	X	X	X	Z
X	X	H	X	Z
L	H	L	X	$B_0^\ddagger$
L	L	L	L	L
L	L	L	H	H

† A-to-B data flow is shown;  $\overline{B}$ -to-A flow control is the same except that it uses  $\overline{CEBA}$ ,  $\overline{LEBA}$ , and  $\overline{OEBA}$ .

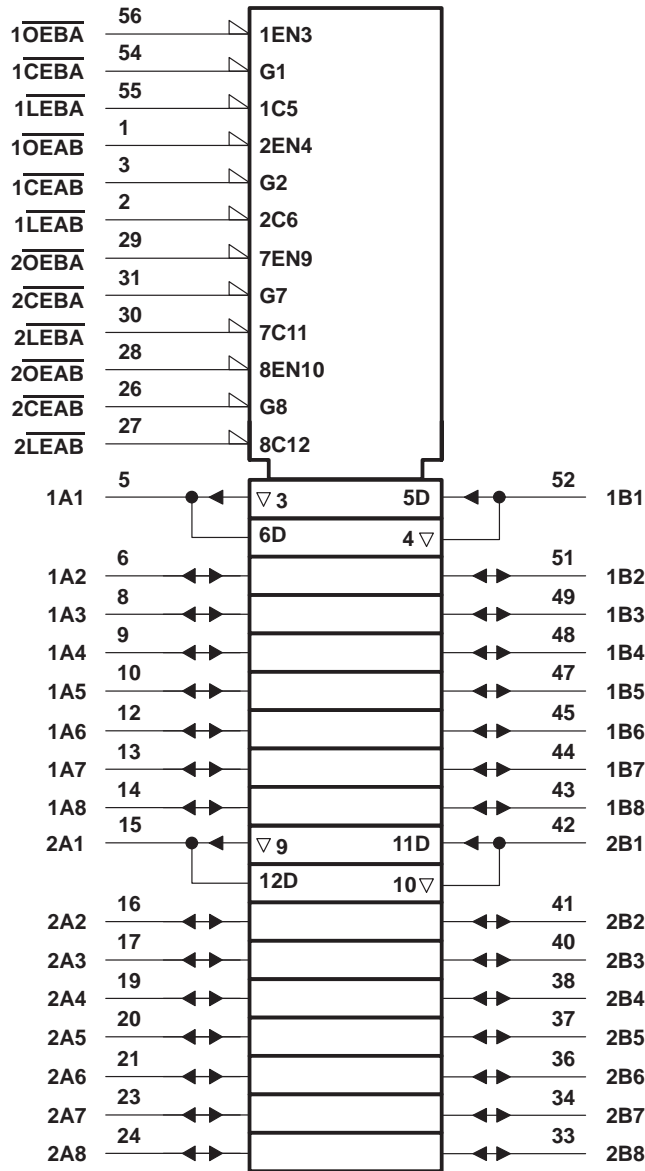
‡ Output level before the indicated steady-state input conditions were established



SN54ABT16543, SN74ABT16543  
 16-BIT REGISTERED TRANSCEIVERS  
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logic symbol†

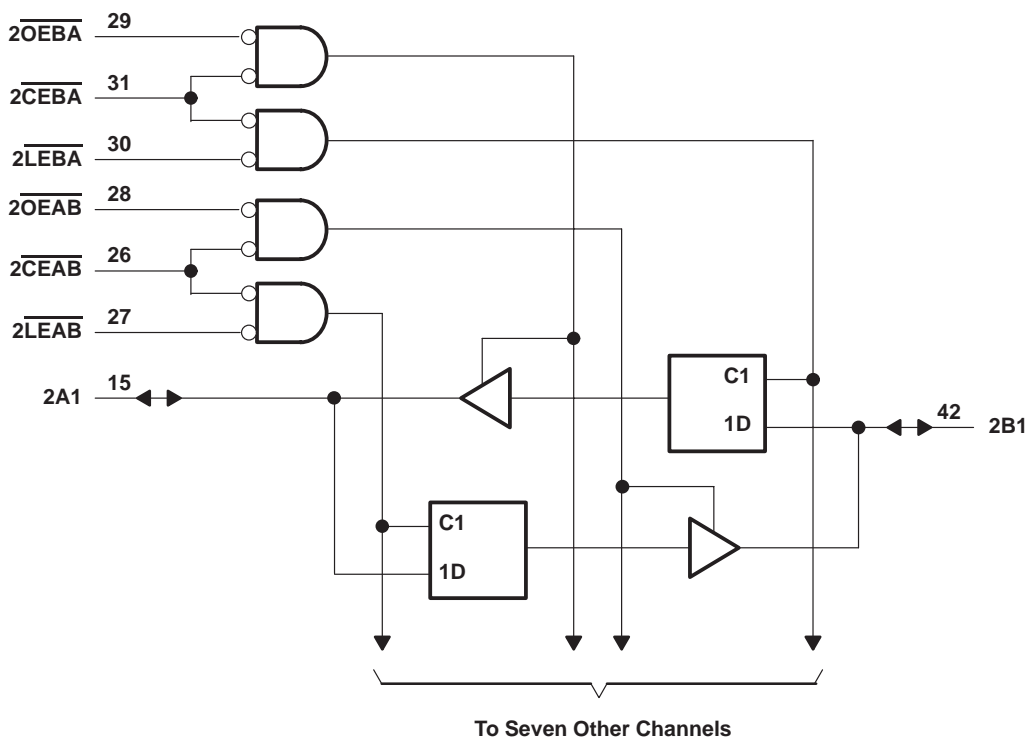
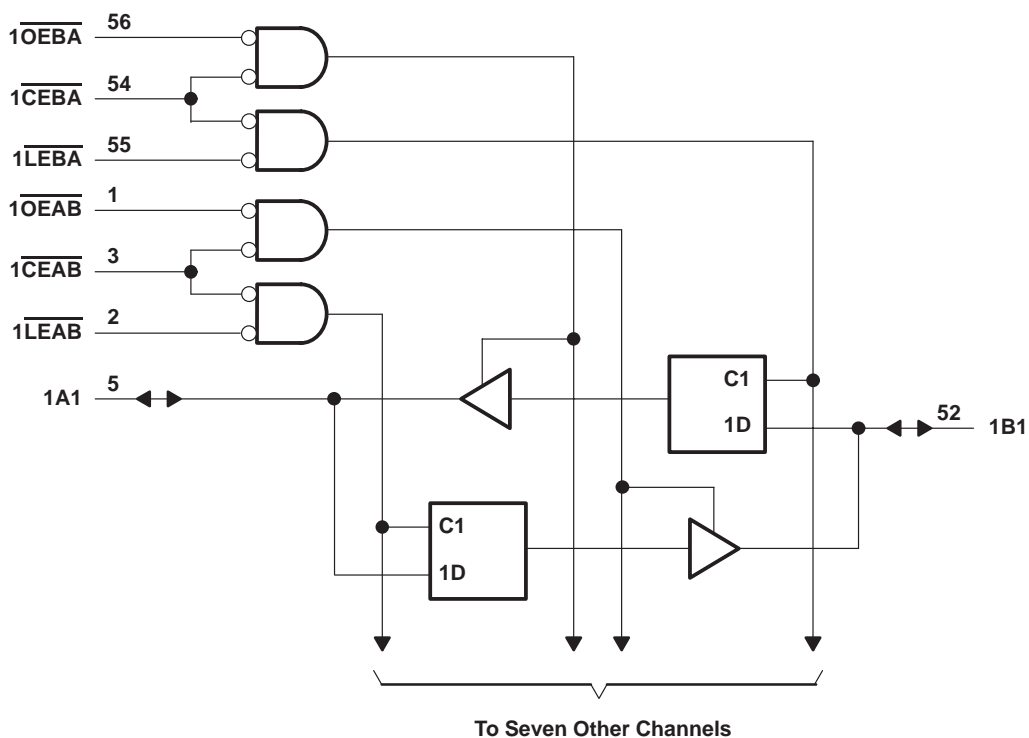


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

# SN54ABT16543, SN74ABT16543 16-BIT REGISTERED TRANSCEIVERS WITH 3-STATE OUTPUTS

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## logic diagram (positive logic)



# SN54ABT16543, SN74ABT16543 16-BIT REGISTERED TRANSCEIVERS WITH 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, $I_O$ : SN54ABT16543 .....	96 mA
SN74ABT16543 .....	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)

		SN54ABT16543		SN74ABT16543		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.

# SN54ABT16543, SN74ABT16543 16-BIT REGISTERED TRANSCEIVERS WITH 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			SN54ABT16543		SN74ABT16543		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				
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 48 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 A or B ports	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND			±1		±1		±1	μA
					±100		±100		±100	
I <sub>OZH</sub> ‡	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.7 V			50**		10		50	μA	
I <sub>OZL</sub> ‡	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0.5 V			-50**		-10		-50	μA	
I <sub>off</sub>	V <sub>CC</sub> = 0, V <sub>I</sub> or V <sub>O</sub> ≤ 4.5 V			±100				±100	μA	
I <sub>CEX</sub>	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 5.5 V	Outputs high		50		50		50	μA	
I <sub>O</sub> §	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.5 V			-50 -100 -200		-50 -200		-50 -200	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		35		35		35	
			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			0.5		0.5		0.5	mA	
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		8.5					pF	

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

\*\* These limits apply only to the SN74ABT16543.

† 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.

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

		V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C		SN54ABT16543		SN74ABT16543		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>w</sub>	Pulse duration, $\overline{\text{LEAB}}$ or $\overline{\text{LEBA}}$ low		4		4		4	ns
t <sub>su</sub>	Setup time, data before $\overline{\text{LEAB}}\uparrow$ or $\overline{\text{LEBA}}\uparrow$	High	1.5		1.5		1.5	ns
		Low	3.5		3.5		3.5	
t <sub>h</sub>	Hold time, data after $\overline{\text{LEAB}}\uparrow$ or $\overline{\text{LEBA}}\uparrow$	High	1.5		1.5		1.5	ns
		Low	2		2		2	



**SN54ABT16543, SN74ABT16543**  
**16-BIT REGISTERED TRANSCEIVERS**  
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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)	SN54ABT16543					UNIT
			$V_{CC} = 5$ V, $T_A = 25^\circ$ C			MIN	MAX	
			MIN	TYP	MAX			
$t_{PLH}$	A or B	B or A	0.8	2.5	3.3	0.8	3.9	ns
$t_{PHL}$			0.9	2.7	4.4	0.9	5.2	
$t_{PLH}$	$\overline{LE}$	A or B	1	3.1	4.3	1	5.3	ns
$t_{PHL}$			1.2	3.3	4.8	1.2	5.7	
$t_{PZH}$	$\overline{OE}$	A or B	0.8	3.4	4.3	0.8	5.3	ns
$t_{PZL}$			1.1	3.8	7	1.1	7.9	
$t_{PHZ}$	$\overline{OE}$	A or B	1.9	4	6.3	1.9	7.2	ns
$t_{PLZ}$			1.6	3.3	4.6	1.6	5	
$t_{PZH}$	$\overline{CE}$	A or B	0.9	3.8	4.9	0.9	6.3	ns
$t_{PZL}$			1.2	4.2	6.8	1.2	7.9	
$t_{PHZ}$	$\overline{CE}$	A or B	2	4.5	6.4	2	7.3	ns
$t_{PLZ}$			1.7	3.9	5.1	1.7	5.6	

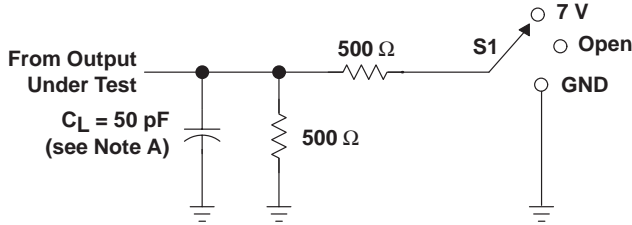
switching characteristics over recommended ranges of supply voltage and operating free-air temperature,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74ABT16543					UNIT
			$V_{CC} = 5$ V, $T_A = 25^\circ$ C			MIN	MAX	
			MIN	TYP	MAX			
$t_{PLH}$	A or B	B or A	1	2.5	3.3	1	3.8	ns
$t_{PHL}$			1	2.7	4.4	1	5.1	
$t_{PLH}$	$\overline{LE}$	A or B	1	3.1	4.3	1	5.2	ns
$t_{PHL}$			1.2	3.3	4.8	1.2	5.6	
$t_{PZH}$	$\overline{OE}$	A or B	1	3.4	4.3	1	5.2	ns
$t_{PZL}$			1.1	3.8	5.9	1.1	7	
$t_{PHZ}$	$\overline{OE}$	A or B	1.9	4	5	1.9	5.7	ns
$t_{PLZ}$			1.6	3.3	4.2	1.6	4.6	
$t_{PZH}$	$\overline{CE}$	A or B	1	3.8	4.9	1	6.2	ns
$t_{PZL}$			1.2	4.2	6.5	1.2	7.8	
$t_{PHZ}$	$\overline{CE}$	A or B	2	4.5	5.6	2	6.6	ns
$t_{PLZ}$			1.7	3.9	5.1	1.7	5.4	

**SN54ABT16543, SN74ABT16543**  
**16-BIT REGISTERED TRANSCEIVERS**  
**WITH 3-STATE OUTPUTS**

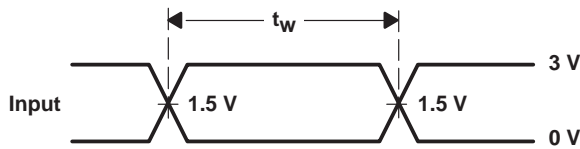
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**PARAMETER MEASUREMENT INFORMATION**

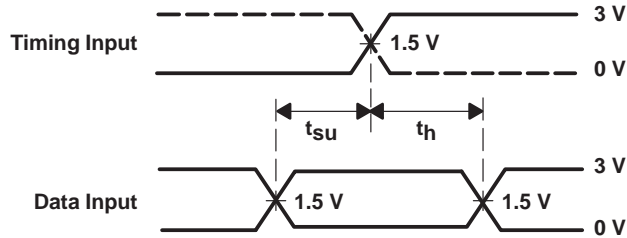


**LOAD CIRCUIT**

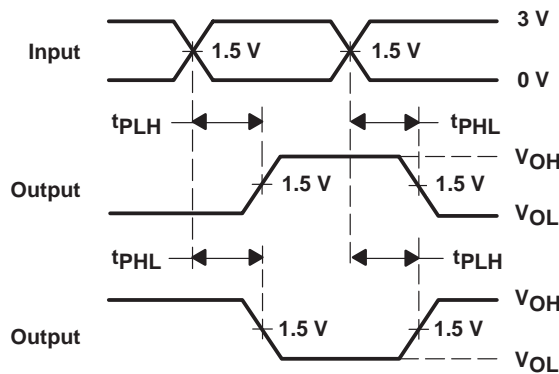
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	7 V
$t_{PHZ}/t_{PZH}$	Open



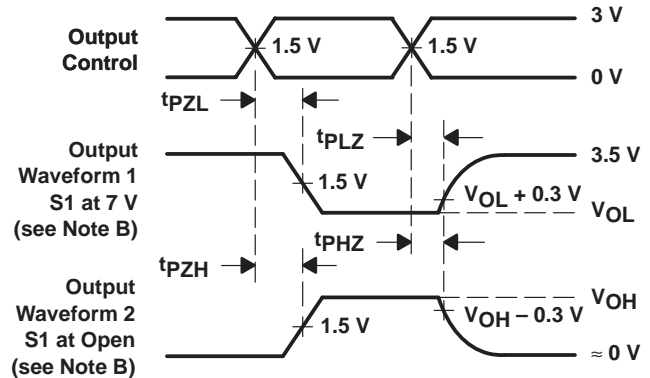
**VOLTAGE WAVEFORMS**  
**PULSE DURATION**



**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**

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-9324101MXA	ACTIVE	CFP	WD	56	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-9324101MX A SNJ54ABT16543W D	<a href="#">Samples</a>
74ABT16543DGGRG4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT16543	<a href="#">Samples</a>
SN74ABT16543DGGR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT16543	<a href="#">Samples</a>
SN74ABT16543DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT16543	<a href="#">Samples</a>
SN74ABT16543DLG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT16543	<a href="#">Samples</a>
SN74ABT16543DLR	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT16543	<a href="#">Samples</a>
SN74ABT16543DLRG4	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT16543	<a href="#">Samples</a>
SNJ54ABT16543WD	ACTIVE	CFP	WD	56	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-9324101MX A SNJ54ABT16543W D	<a href="#">Samples</a>

(1) 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.

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

(2) 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)

- (3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
- (4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.
- (5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.
- (6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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**OTHER QUALIFIED VERSIONS OF SN54ABT16543, SN74ABT16543 :**

- Catalog: [SN74ABT16543](#)
- Military: [SN54ABT16543](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

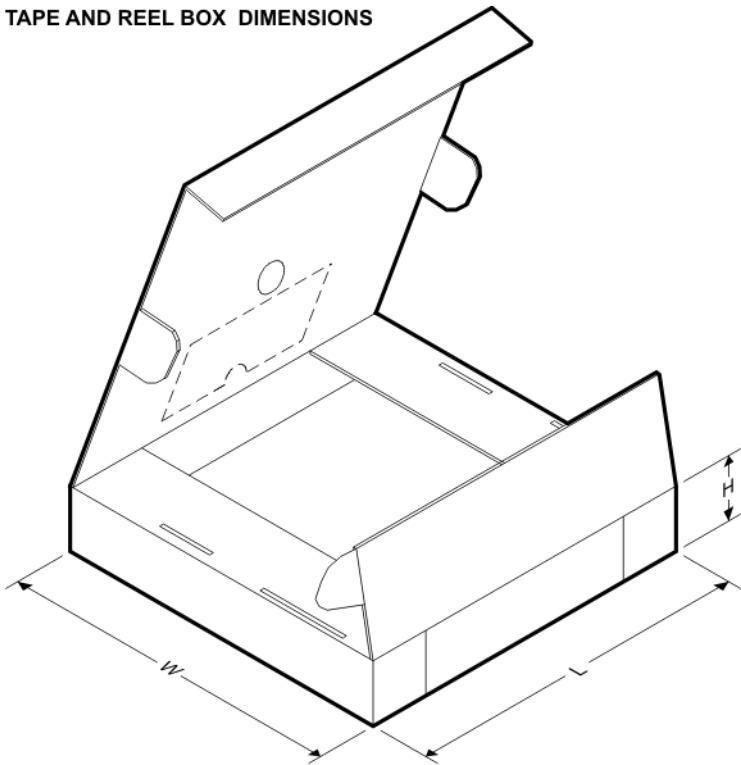
**TAPE DIMENSIONS**


A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

**TAPE AND REEL INFORMATION**

\*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
SN74ABT16543DGGR	TSSOP	DGG	56	2000	330.0	24.4	8.6	15.6	1.8	12.0	24.0	Q1
SN74ABT16543DLR	SSOP	DL	56	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


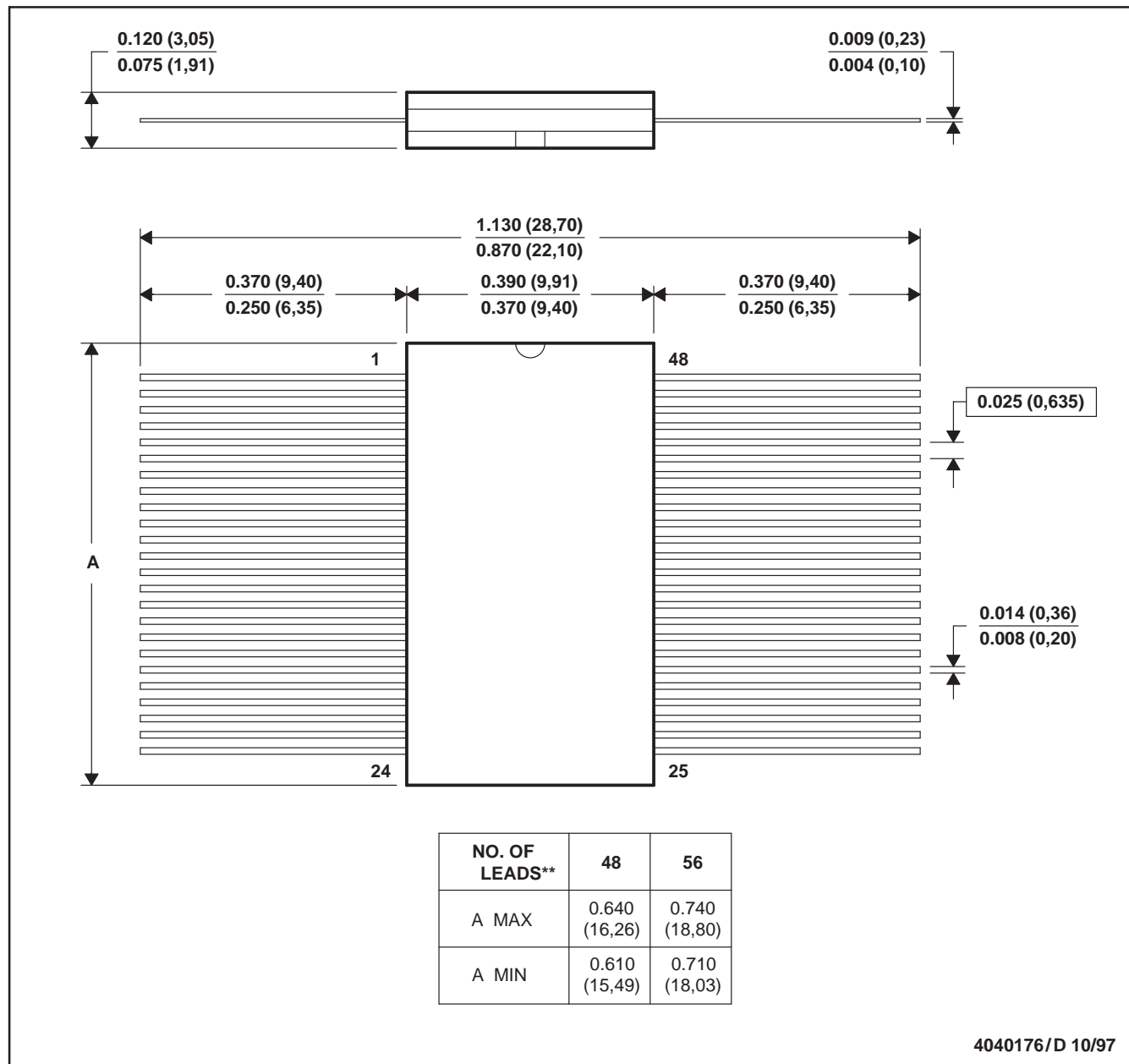
\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ABT16543DGGR	TSSOP	DGG	56	2000	367.0	367.0	45.0
SN74ABT16543DLR	SSOP	DL	56	1000	367.0	367.0	55.0

WD (R-GDFP-F\*\*)

CERAMIC DUAL FLATPACK

48 LEADS SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a ceramic lid using glass frit.  
 D. Index point is provided on cap for terminal identification only  
 E. Falls within MIL STD 1835: GDFP1-F48 and JEDEC MO-146AA  
 GDFP1-F56 and JEDEC MO-146AB

# MECHANICAL DATA

DL (R-PDSO-G56)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - Falls within JEDEC MO-118

PowerPAD is a trademark of Texas Instruments.

DGG (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



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