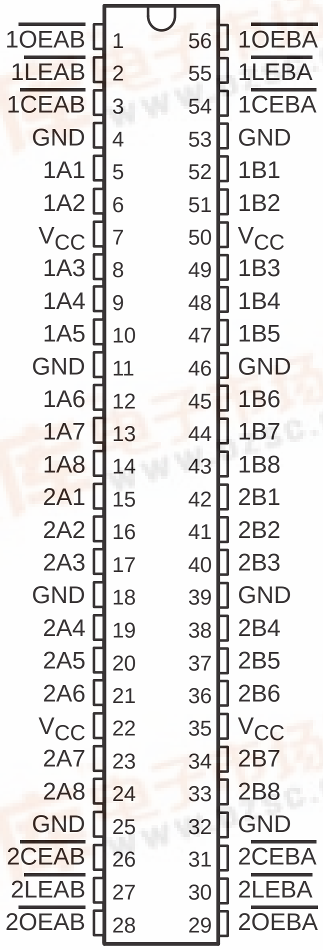
SN54ABT16543, SN74ABT16543
16-BIT REGISTERED TRANSCEIVERS WITH 3-STATE OUTPUTS

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°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 or 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°C to 125°C. The SN74ABT16543 is characterized for operation from –40°C to 85°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.

Widebus and EPIC-IIB are trademarks of Texas Instruments Incorporated.

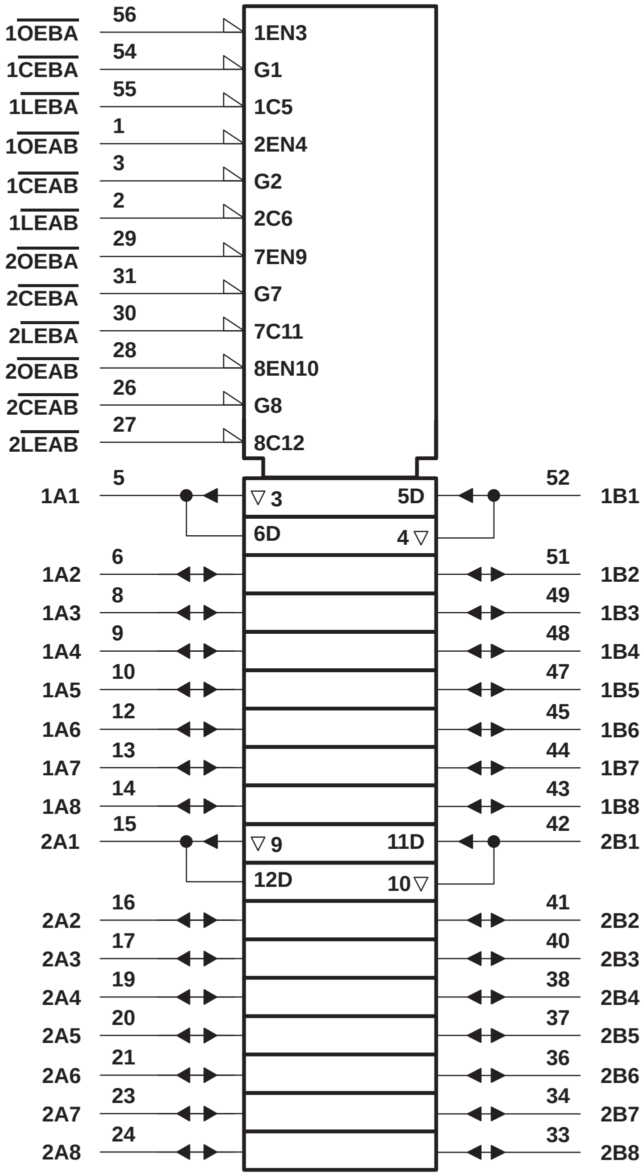
FUNCTION TABLE[†]
(each 8-bit section)

INPUTS				OUTPUT
$\overline{\text{CEAB}}$	$\overline{\text{LEAB}}$	$\overline{\text{OEAB}}$	A	B
H	X	X	X	Z
X	X	H	X	Z
L	H	L	X	B_0[‡]
L	L	L	L	L
L	L	L	H	H

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

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

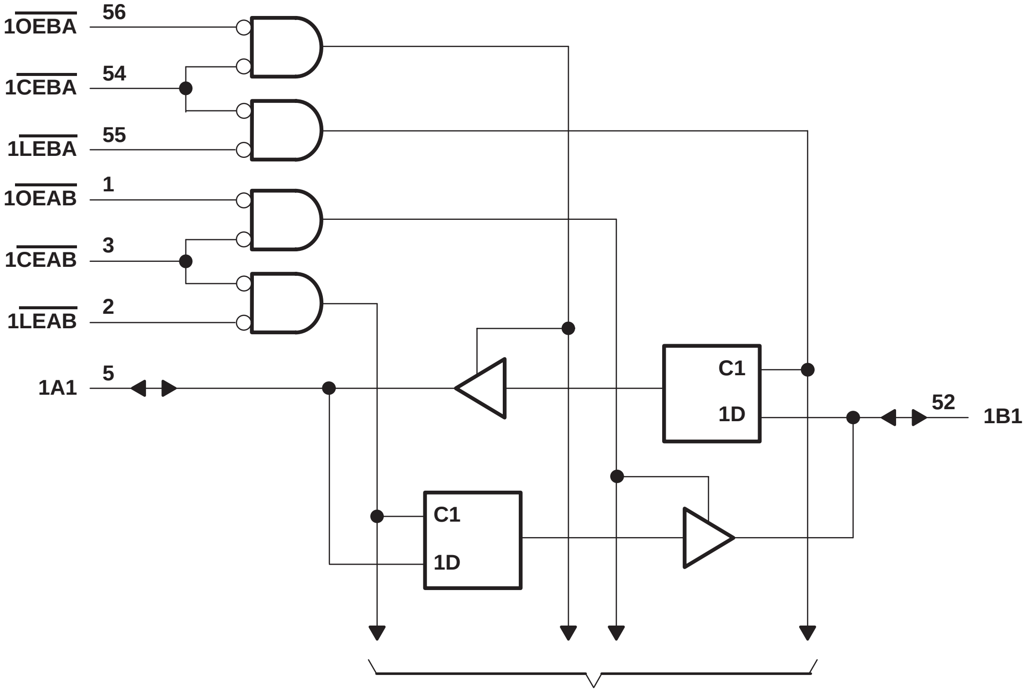
logic symbol†



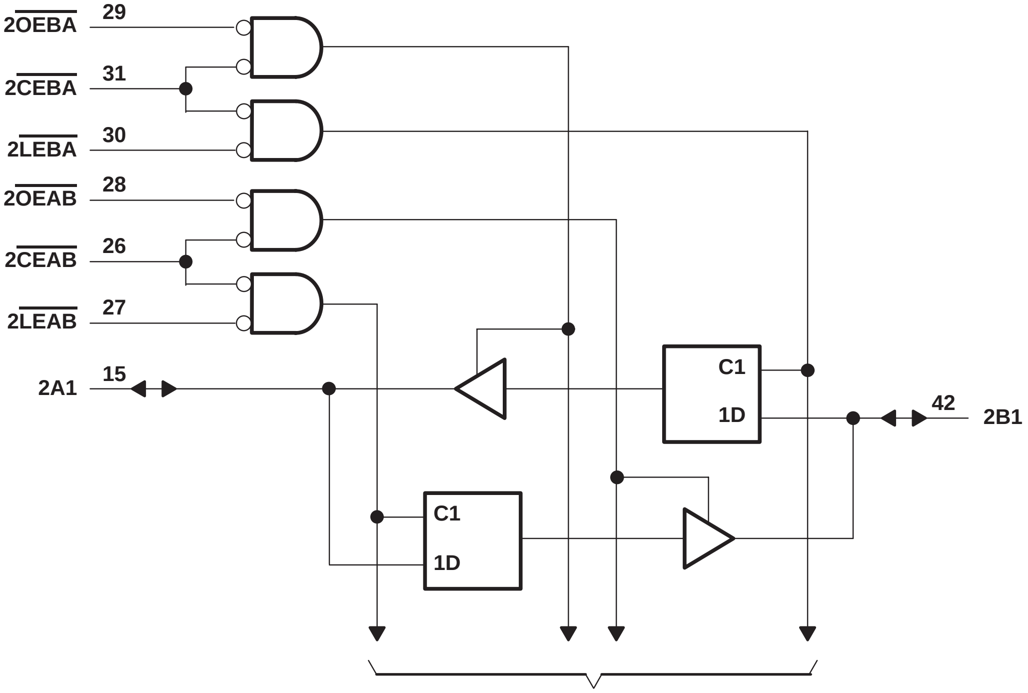
---

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

logic diagram (positive logic)



To Seven Other Channels



To Seven Other Channels

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, 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.

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		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		$T_A = 25°C$			SN54ABT16543		SN74ABT16543		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					±100		±100		±100	
I_{OZH}[‡]		$V_{CC} = 5.5$ V,	$V_O = 2.7$ V			50**		10		50	µA
I_{OZL}[‡]		$V_{CC} = 5.5$ V,	$V_O = 0.5$ V			–50**		–10		–50	µA
I_{off}		$V_{CC} = 0$,	V_I or $V_O \leq 4.5$ 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	–200	–50	–200	–50	–200	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			35		35		35	
			Outputs disabled			2		2		2	
ΔI_{CC}[¶]		$V_{CC} = 5.5$ V, One input at 3.4 V, Other inputs at V_{CC} or GND				0.5		0.5		0.5	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			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 $V_{CC} = 5$ 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 1)

			$V_{CC} = 5$ V, $T_A = 25°C$		SN54ABT16543		SN74ABT16543		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
t_w	Pulse duration, $\overline{\text{LEAB}}$ or $\overline{\text{LEBA}}$ low		4		4		4		ns
t_{su}	Setup time, data before $\overline{\text{LEAB}}$↑ or $\overline{\text{LEBA}}$↑	High	1.5		1.5		1.5		ns
		Low	3.5		3.5		3.5		
t_h	Hold time, data after $\overline{\text{LEAB}}$↑ or $\overline{\text{LEBA}}$↑	High	1.5		1.5		1.5		ns
		Low	2		2		2		

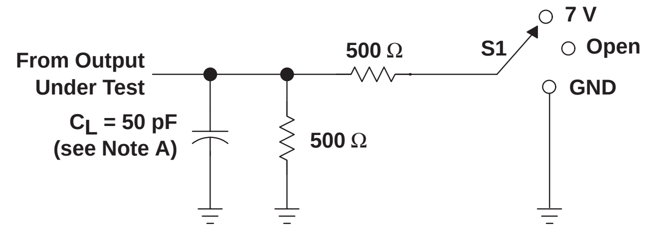
switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C_L = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54ABT16543					UNIT
			V_{CC} = 5 V, T_A = 25°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}	$\overline{\text{LE}}$	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}	$\overline{\text{OE}}$	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}	$\overline{\text{OE}}$	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}	$\overline{\text{CE}}$	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}	$\overline{\text{CE}}$	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)

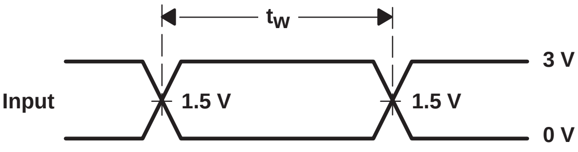
PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74ABT16543					UNIT
			V_{CC} = 5 V, T_A = 25°C			MIN	MAX	
			MIN	TYP	MAX			
t_{PLH}	A or B	B or A	1	2.5	3.3	1	3.8	ns
t_{PHL}			1	2.7	4.4	1	5.1	
t_{PLH}	$\overline{\text{LE}}$	A or B	1	3.1	4.3	1	5.2	ns
t_{PHL}			1.2	3.3	4.8	1.2	5.6	
t_{PZH}	$\overline{\text{OE}}$	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}	$\overline{\text{OE}}$	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}	$\overline{\text{CE}}$	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}	$\overline{\text{CE}}$	A or B	2	4.5	5.6	2	6.6	ns
t_{PLZ}			1.7	3.9	5.1	1.7	5.4	

PARAMETER MEASUREMENT INFORMATION

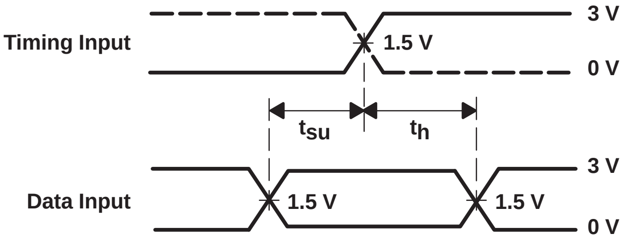


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open

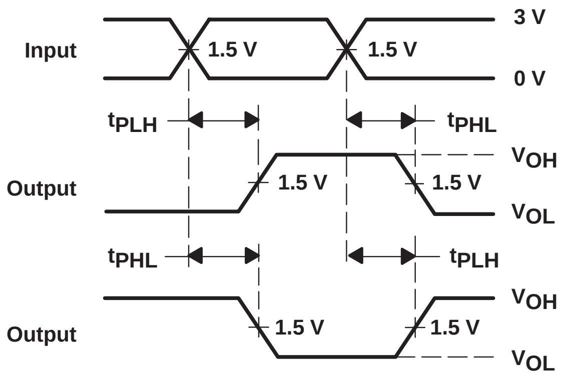
LOAD CIRCUIT



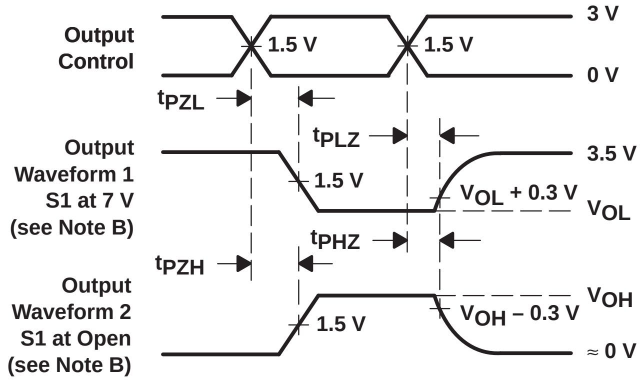
VOLTAGE WAVEFORMS
PULSE DURATION



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 1. Load Circuit and Voltage Waveforms

PACKAGE OPTION ADDENDUM

9-Oct-2007

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
5962-9324101MXA	ACTIVE	CFP	WD	56	1	TBD	A42 SNPB	N / A for Pkg Type
74ABT16543DGGRE4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ABT16543DGGRG4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16543DGGR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16543DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16543DLG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16543DLR	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16543DLRG4	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54ABT16543WD	ACTIVE	CFP	WD	56	1	TBD	A42 SNPB	N / A for Pkg Type

[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.

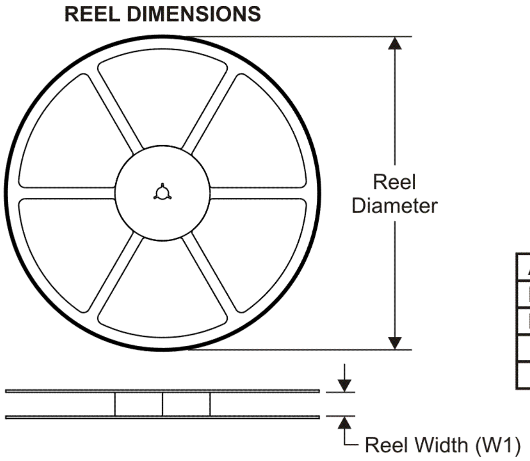
[2] Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been 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)

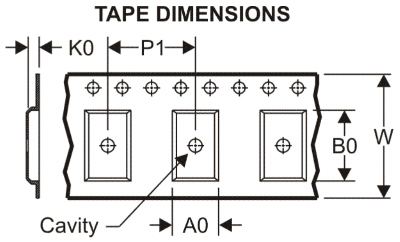
[3] MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

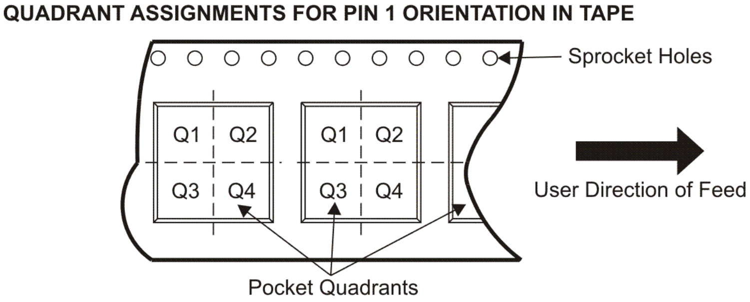
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION





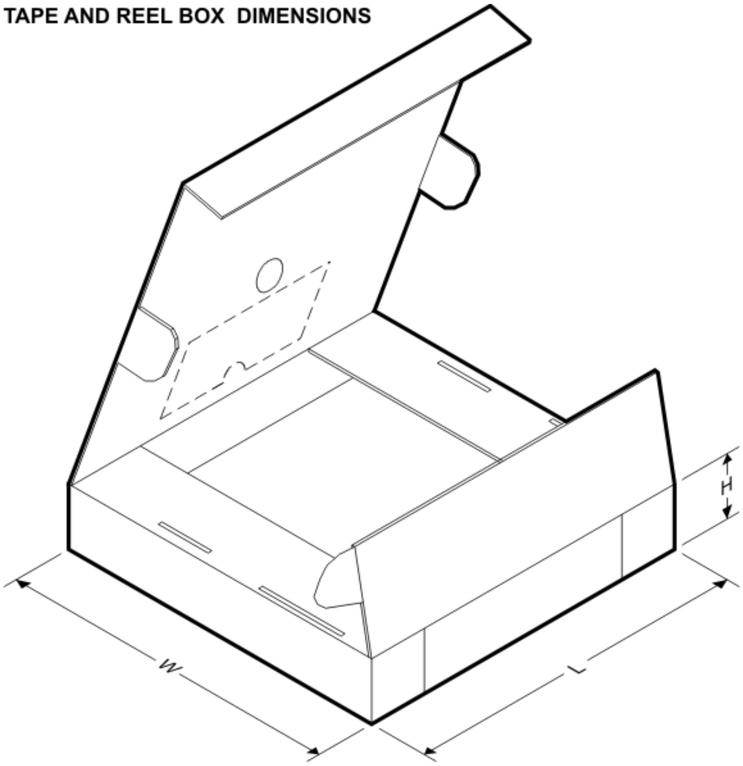
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers



*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

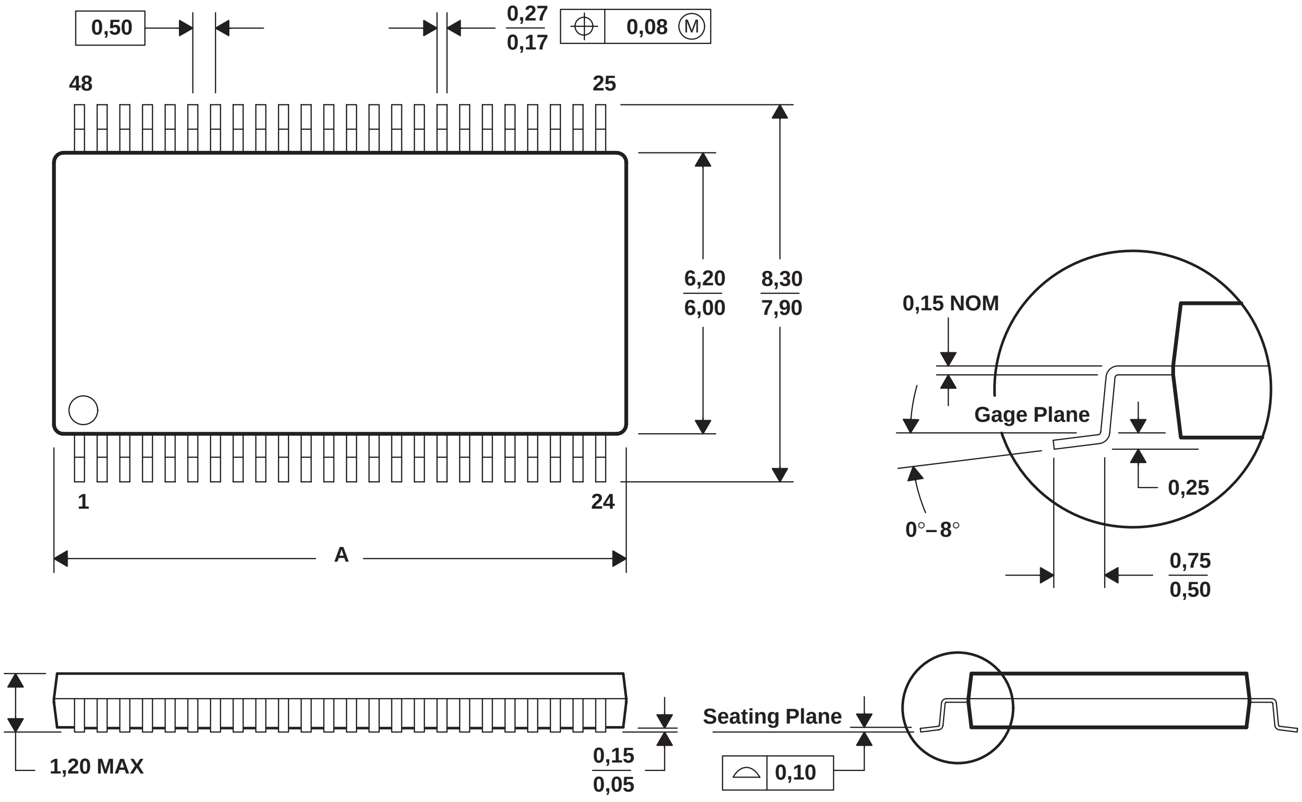


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ABT16543DGGR	TSSOP	DGG	56	2000	346.0	346.0	41.0
SN74ABT16543DLR	SSOP	DL	56	1000	346.0	346.0	49.0

DGG (R-PDSO-G**) PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



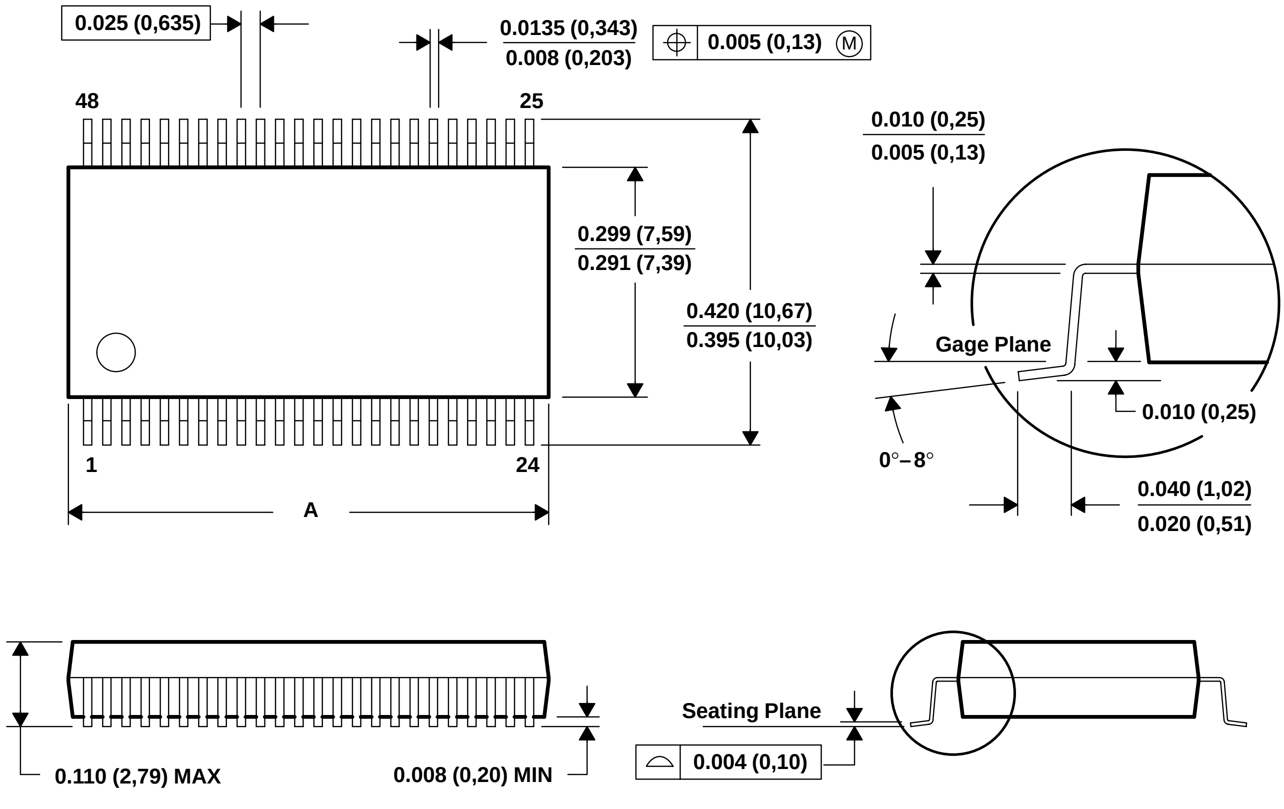
DIM \ PINS **	48	56	64
A MAX	12,60	14,10	17,10
A MIN	12,40	13,90	16,90

4040078 / F 12/97

NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold protrusion not to exceed 0,15.
- D. Falls within JEDEC MO-153

DL (R-PDSO-G**) PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



PINS ** DIM	28	48	56
A MAX	0.380 (9,65)	0.630 (16,00)	0.730 (18,54)
A MIN	0.370 (9,40)	0.620 (15,75)	0.720 (18,29)

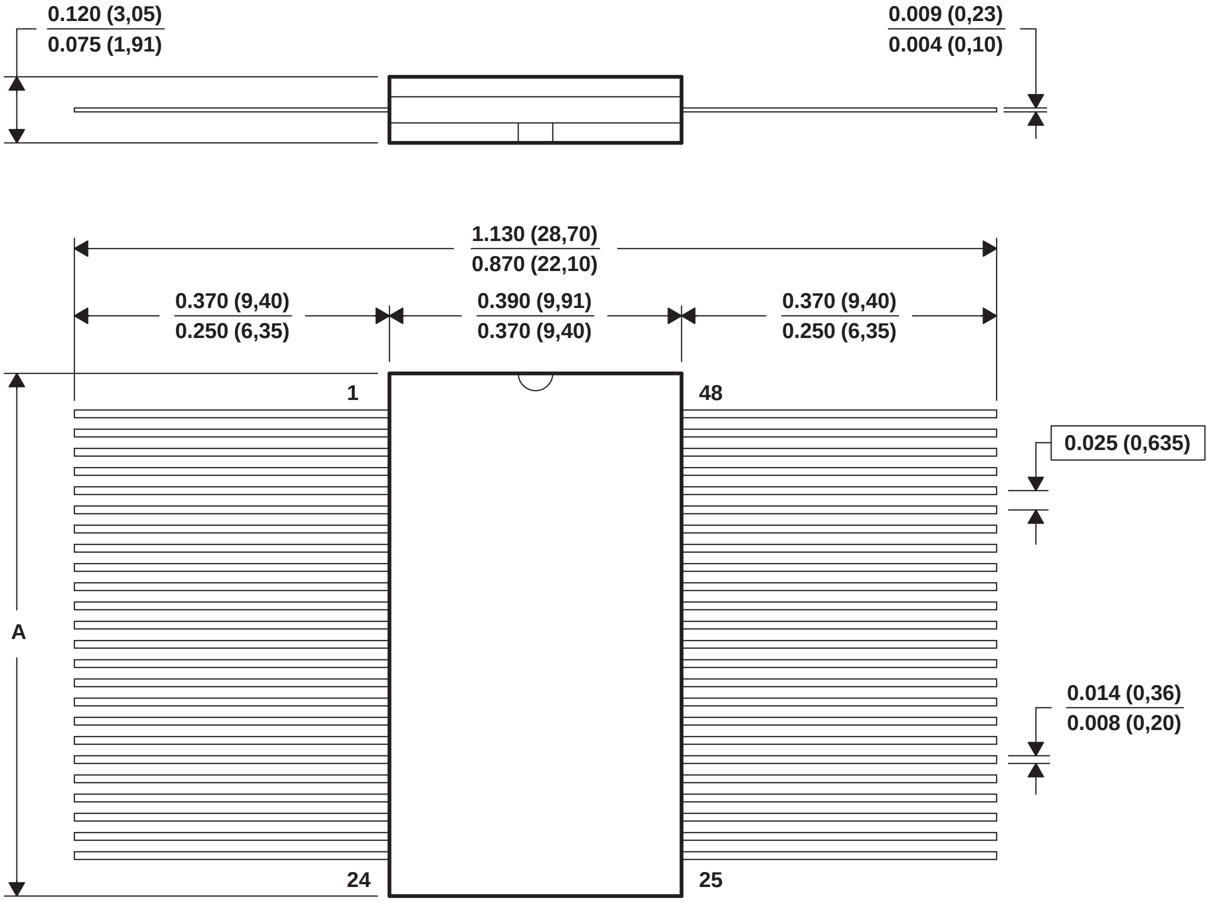
4040048/E 12/01

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

WD (R-GDFP-F**)

CERAMIC DUAL FLATPACK

48 LEADS SHOWN



NO. OF LEADS**	48	56
A MAX	0.640 (16,26)	0.740 (18,80)
A MIN	0.610 (15,49)	0.710 (18,03)

4040176/D 10/97

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

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Clocks and Timers	www.ti.com/clocks	Digital Control	www.ti.com/digitalcontrol
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265