

16-BIT REGISTERED TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS082C – FEBRUARY 1991 – REVISED JANUARY 1997

- **Members of the Texas Instruments Widebus™ Family**
- **State-of-the-Art EPIC-II™ 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 ($-32\text{-mA } I_{OH}$, $64\text{-mA } I_{OL}$)**
- **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**

description

The 'ABT16952 are 16-bit registered transceivers that contain two sets of D-type flip-flops for temporary storage of data flowing in either direction. The 'ABT16952 can be used as two 8-bit transceivers or one 16-bit transceiver. Data on the A or B bus is stored in the registers on the low-to-high transition of the clock (CLKAB or CLKBA) input provided that the clock-enable (CLKENAB or CLKENBA) input is low. Taking the output-enable ($\overline{OEAB}$ or $\overline{OEBA}$) input low accesses the data on either port.

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 SN54ABT16952 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74ABT16952 is characterized for operation from -40°C to 85°C .

SN54ABT16952 . . . WD PACKAGE
SN74ABT16952 . . . DGG OR DL PACKAGE
(TOP VIEW)

$\overline{1OEAB}$	1	56	$\overline{1OEBA}$
$\overline{1CLKAB}$	2	55	$\overline{1CLKBA}$
$\overline{1CLKENAB}$	3	54	$\overline{1CLKENBA}$
GND	4	53	GND
1A1	5	52	1B1
1A2	6	51	1B2
V_{CC}	7	50	V_{CC}
1A3	8	49	1B3
1A4	9	48	1B4
1A5	10	47	1B5
GND	11	46	GND
1A6	12	45	1B6
1A7	13	44	1B7
1A8	14	43	1B8
2A1	15	42	2B1
2A2	16	41	2B2
2A3	17	40	2B3
GND	18	39	GND
2A4	19	38	2B4
2A5	20	37	2B5
2A6	21	36	2B6
V_{CC}	22	35	V_{CC}
2A7	23	34	2B7
2A8	24	33	2B8
GND	25	32	GND
$\overline{2CLKENAB}$	26	31	$\overline{2CLKENBA}$
$\overline{2CLKAB}$	27	30	$\overline{2CLKBA}$
$\overline{2OEAB}$	28	29	$\overline{2OEBA}$

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SN54ABT16952, SN74ABT16952
16-BIT REGISTERED TRANSCEIVERS
WITH 3-STATE OUTPUTS

SCBS082C – FEBRUARY 1991 – REVISED JANUARY 1997

FUNCTION TABLE[†]

INPUTS				OUTPUT B
CLKENAB	CLKAB	OEAB	A	
H	X	L	X	B ₀ [‡]
X	L	L	X	B ₀ [‡]
L	↑	L	L	L
L	↑	L	H	H
X	X	H	X	Z

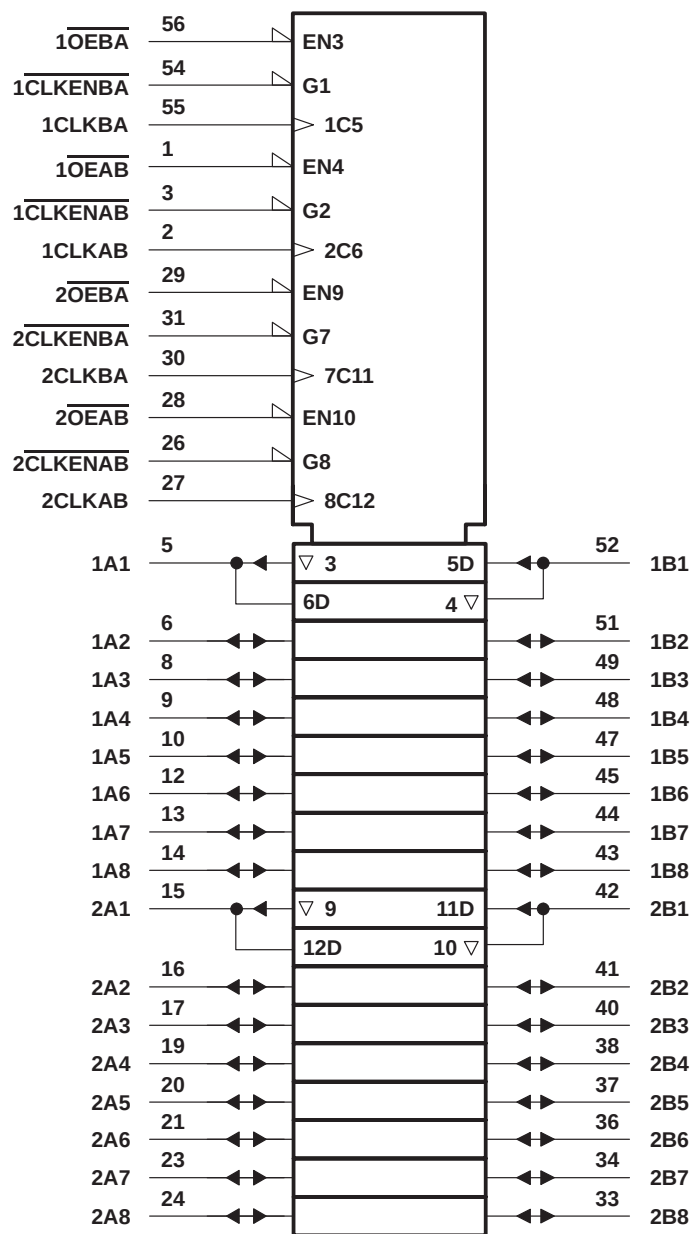
[†] A-to-B data flow is shown; B-to-A data flow is similar, but uses $\overline{\text{CLKENBA}}$, $\overline{\text{CLKBA}}$, and $\overline{\text{OEBA}}$.

[‡] Level of B before the indicated steady-state input conditions were established

SN54ABT16952, SN74ABT16952 16-BIT REGISTERED TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS082C – FEBRUARY 1991 – REVISED JANUARY 1997

logic symbol[†]



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

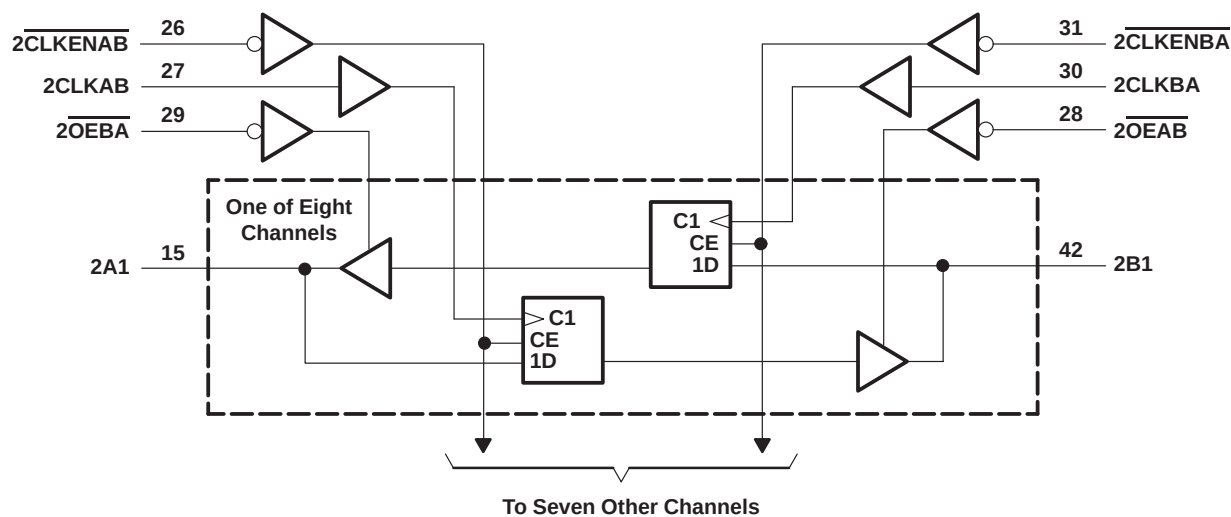
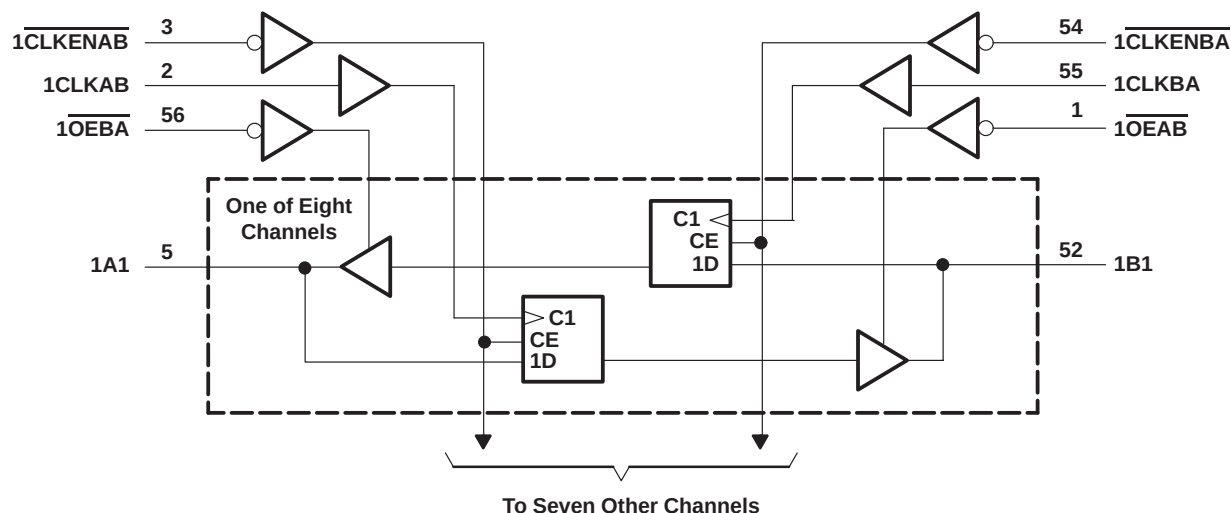
SN54ABT16952, SN74ABT16952

16-BIT REGISTERED TRANSCEIVERS

WITH 3-STATE OUTPUTS

SCBS082C – FEBRUARY 1991 – REVISED JANUARY 1997

logic diagram (positive logic)



SN54ABT16952, SN74ABT16952 16-BIT REGISTERED TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS082C – FEBRUARY 1991 – REVISED JANUARY 1997

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 : SN54ABT16952	96 mA
SN74ABT16952	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)

		SN54ABT16952		SN74ABT16952		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		10		10	ns/V
	Outputs enabled					
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.

SN54ABT16952, SN74ABT16952

16-BIT REGISTERED TRANSCEIVERS

WITH 3-STATE OUTPUTS

SCBS082C – FEBRUARY 1991 – REVISED JANUARY 1997

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

PARAMETER		TEST CONDITIONS	$T_A = 25^\circ\text{C}$			SN54ABT16952		SN74ABT16952		UNIT
			MIN	TYP [†]	MAX	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		
		$V_{CC} = 4.5\text{ V}$	2			2				
									2	
V_{OL}		$V_{CC} = 4.5\text{ V}$			0.55	0.55			0.55	V
					0.55*					
V_{hys}				100						mV
I_I	Control inputs	$V_{CC} = 5.5\text{ V}$, $V_I = V_{CC}\text{ or GND}$			± 1	± 1		± 1		μA
	A or B ports									
$I_{OZH}^\ddagger$		$V_{CC} = 5.5\text{ V}$, $V_O = 2.7\text{ V}$			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}		$V_{CC} = 0$, $V_I\text{ or }V_O \leq 4.5\text{ V}$			± 100				± 100	μA
I_{CEX}		$V_{CC} = 5.5\text{ V}$, $V_O = 5.5\text{ V}$			50		50		50	μA
$I_O^\S$		$V_{CC} = 5.5\text{ V}$, $V_O = 2.5\text{ V}$	-50	-100	-200	-50	-200	-50	-200	mA
I_{CC}	A or B ports	$V_{CC} = 5.5\text{ V}$, $I_O = 0$, $V_I = V_{CC}\text{ or GND}$			2	2		2	2	mA
$\Delta I_{CC}^\P$		$V_{CC} = 5.5\text{ V}$, One input at 3.4 V, Other inputs at $V_{CC}\text{ or GND}$			0.5		0.5		0.5	mA
C_i	Control inputs	$V_I = 2.5\text{ V or }0.5\text{ V}$			3					pF
C_{io}	A or B ports	$V_O = 2.5\text{ V or }0.5\text{ V}$			8.5					pF

* On products compliant to MIL-PRF-38535, 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.

SN54ABT16952, SN74ABT16952
16-BIT REGISTERED TRANSCEIVERS
WITH 3-STATE OUTPUTS

SCBS082C – FEBRUARY 1991 – REVISED JANUARY 1997

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

			$V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$		SN54ABT16952		SN74ABT16952		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		0	150	0	150	0	150	MHz
$t_W^\dagger$	Pulse duration, CLKAB or CLKBA high or low		3.3		3.3		3.3		ns
t_{su}	Setup time, before CLKAB $\uparrow$ or CLKBA $\uparrow$	A or B	3.5		3.5		3.5		ns
		$\overline{\text{CLKENAB}}$ or $\overline{\text{CLKENBA}}$	3		3		3		
t_h	Hold time, after CLKAB $\uparrow$ or CLKBA $\uparrow$	A or B	1		1		1		ns
		$\overline{\text{CLKENAB}}$ or $\overline{\text{CLKENBA}}$	1		1		1		

$\dagger$ This parameter is warranted, but not production tested.

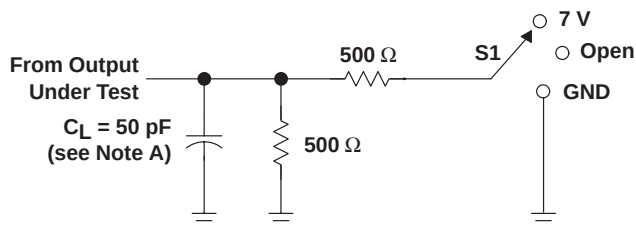
switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$			SN54ABT16952		SN74ABT16952		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			150			150		150		MHz
t_{PLH}	CLK	A or B	1	2.6	3.9	1	4.4	1	4.3	ns
t_{PHL}			1	2.6	4.2	1	4.6	1	4.5	
t_{PZH}	$\overline{\text{OE}}$	A or B	1	2.5	3.8	1	4.7	1	4.6	ns
t_{PZL}			1	2.8	5.1	1	6.1	1	6	
t_{PHZ}	$\overline{\text{OE}}$	A or B	1.7	3.4	4.7	1.7	6.1	1.7	5.5	ns
t_{PLZ}			1.3	3	3.9	1.3	4.8	1.3	4.2	

SN54ABT16952, SN74ABT16952 16-BIT REGISTERED TRANSCEIVERS WITH 3-STATE OUTPUTS

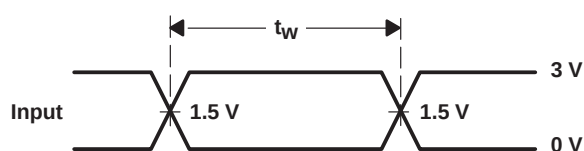
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PARAMETER MEASUREMENT INFORMATION

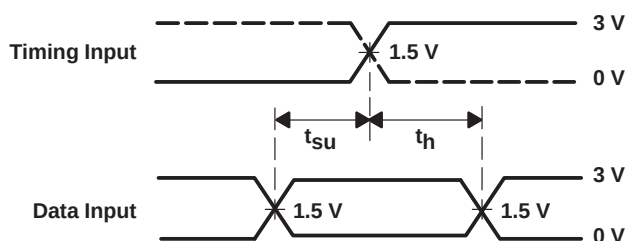


LOAD CIRCUIT

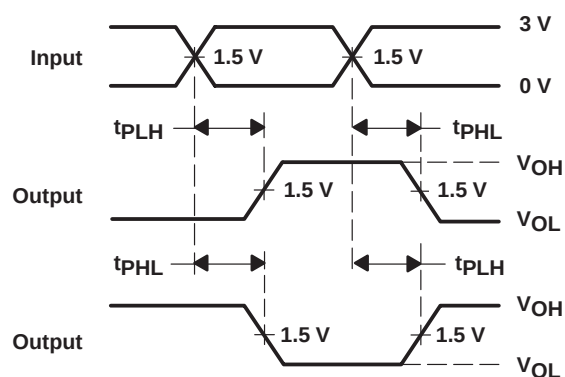
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open



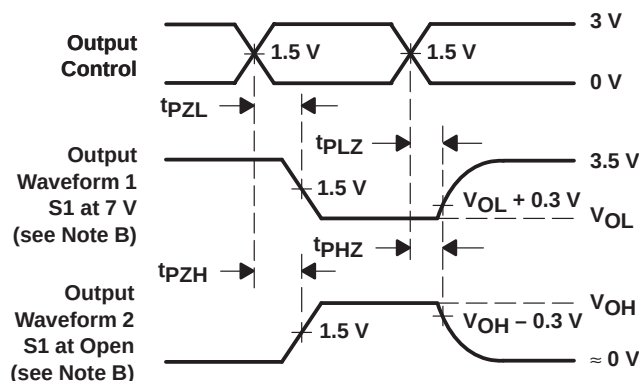
VOLTAGE WAVEFORMS
PULSE DURATION



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:
- C_L includes probe and jig capacitance.
 - 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.
 - All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
 - 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	MSL Peak Temp ⁽³⁾
74ABT16952DGGRE4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ABT16952DGGRG4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16952DGGR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16952DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16952DLG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16952DLR	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT16952DLRG4	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

⁽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.

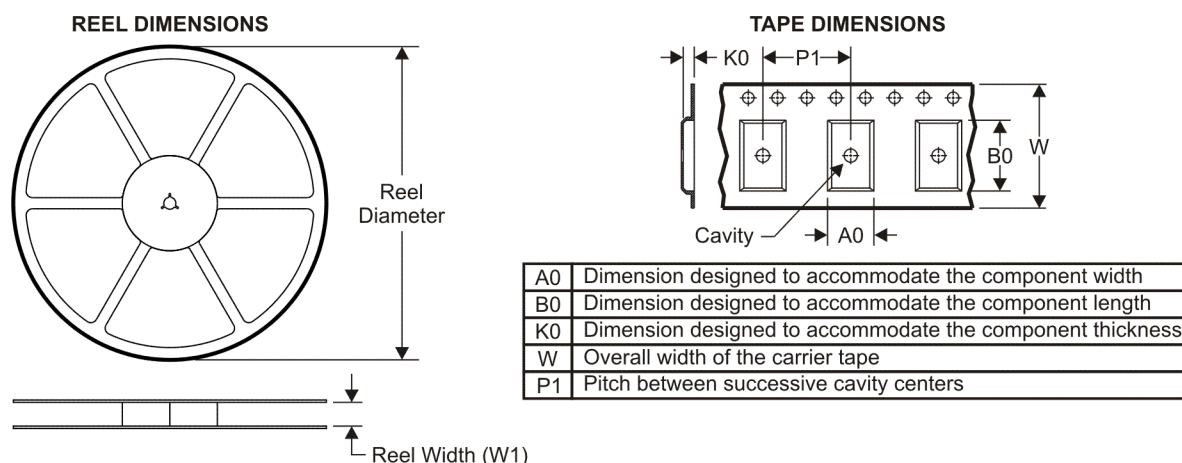
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

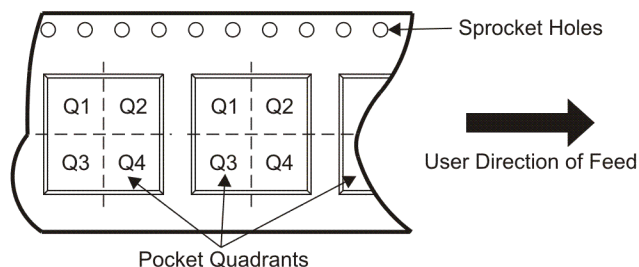
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TAPE AND REEL INFORMATION



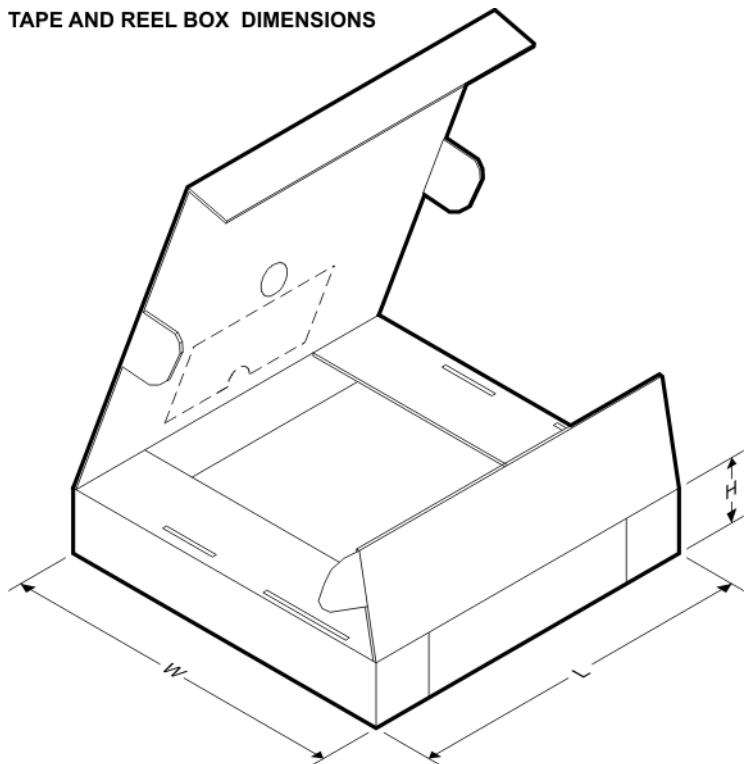
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN74ABT16952DGGR	TSSOP	DGG	56	2000	330.0	24.4	8.6	15.6	1.8	12.0	24.0	Q1
SN74ABT16952DLR	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)
SN74ABT16952DGGR	TSSOP	DGG	56	2000	346.0	346.0	41.0
SN74ABT16952DLR	SSOP	DL	56	1000	346.0	346.0	49.0

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