

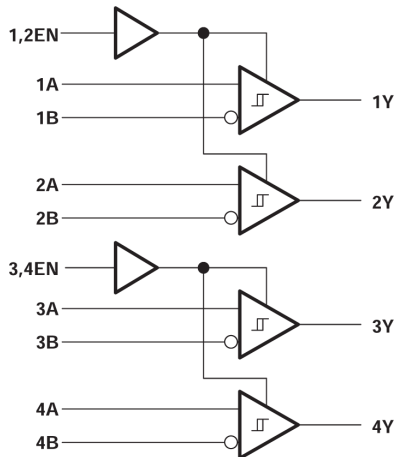
# SN65LBC175A, SN75LBC175A Quadruple RS-485 Differential Line Receivers

## 1 Features

- Designed for TIA/EIA-485, TIA/EIA-422, and ISO 8482 applications
- Signaling rate exceeding 50 Mbps
- Fail-safe in bus short-circuit, open-circuit, and idle-bus conditions
- ESD protection on bus inputs 6 kV
- Common-mode bus input range  $-7\text{ V}$  to  $12\text{ V}$
- Propagation delay times  $<16\text{ ns}$
- Low standby power consumption  $<20\text{ }\mu\text{A}$
- Pin-compatible upgrade for MC3486, DS96F175, LTC489, and SN75175

## 2 Applications

- Factory automation
- ATM and cash counters
- Smart grid
- AC and servo motor drives



Logic Diagram<sup>1</sup>

## 3 Description

The SN65LBC175A and SN75LBC175A are quadruple differential line receivers with 3-state outputs, designed for TIA/EIA-485 (RS-485), TIA/EIA-422 (RS-422), and ISO 8482 (Euro RS-485) applications.

These devices are optimized for balanced multipoint bus communication at data rates up to and exceeding 50 million bits per second. The transmission media may be twisted-pair cables, printed-circuit board traces, or backplanes. The ultimate rate and distance of data transfer is dependent upon the attenuation characteristics of the media and the noise coupling to the environment.

Each receiver operates over a wide range of positive and negative common-mode input voltages, and features ESD protection to 6 kV, making it suitable for high-speed multipoint data transmission applications in harsh environments. These devices are designed using LinBiCMOS™, facilitating low power consumption and inherent robustness.

Two EN inputs provide pair-wise enable control, or these can be tied together externally to enable all four drivers with the same signal.

The SN75LBC175A is characterized for operation over the temperature range of  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ . The SN65LBC175A is characterized over the temperature range from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

### Package Information

PART NUMBER	PACKAGE <sup>(1)</sup>	PACKAGE SIZE <sup>(2)</sup>
SN65LBC175A	SOIC (D, 16)	9.9 mm × 6 mm
SN75LBC175A	PDIP (N, 16)	19.3 mm × 9.4 mm

(1) For more information, see Section 11.

(2) The package size (length × width) is a nominal value and includes pins, where applicable.

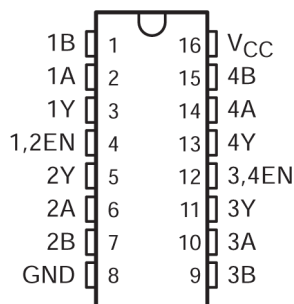
<sup>1</sup> The signaling rate of a line is the number of voltage transitions that are made per second expressed in the units bps (bits per second).



## Table of Contents

<b>1 Features</b> .....	<b>1</b>	<b>7 Detailed Description</b> .....	<b>11</b>
<b>2 Applications</b> .....	<b>1</b>	7.1 Device Functional Modes.....	11
<b>3 Description</b> .....	<b>1</b>	<b>8 Application and Implementation</b> .....	<b>12</b>
<b>4 Pin Configuration and Functions</b> .....	<b>3</b>	8.1 Typical Application.....	12
<b>5 Specifications</b> .....	<b>4</b>	<b>9 Device and Documentation Support</b> .....	<b>14</b>
5.1 Absolute Maximum Ratings.....	4	9.1 Receiving Notification of Documentation Updates....	14
5.2 ESD Ratings.....	4	9.2 Support Resources.....	14
5.3 Dissipation Rating Table.....	4	9.3 Trademarks.....	14
5.4 Thermal Information.....	4	9.4 Electrostatic Discharge Caution.....	14
5.5 Recommended Operating Conditions.....	5	9.5 Glossary.....	14
5.6 Electrical Characteristics.....	5	<b>10 Revision History</b> .....	<b>14</b>
5.7 Switching Characteristics.....	6	<b>11 Mechanical, Packaging, and Orderable</b>	
5.8 Typical Characteristics.....	7	<b>Information</b> .....	14
<b>6 Parameter Measurement Information</b> .....	<b>9</b>		

## 4 Pin Configuration and Functions



**Figure 4-1. SN65LBC175A (Marked as 65LBC175A)  
SN75LBC175A (Marked as 75LBC175A)  
D or N Package (Top View)**

**Table 4-1. Pin Functions**

PIN		TYPE <sup>(1)</sup>	DESCRIPTION
NAME	NO.		
1B	1	I	Channel 1 Inverting Differential Input
1A	2	I	Channel 1 Non-Inverting Differential Input
1Y	3	O	Channel 1 Output
1,2 EN	4	I	Channel 1 and 2 Active High Enable
2Y	5	O	Channel 2 Output
2A	6	I	Channel 2 Non-Inverting Differential Input
2B	7	I	Channel 2 Inverting Differential Input
GND	8	GND	Device Ground
3B	9	I	Channel 3 Inverting Differential Input
3A	10	I	Channel 3 Non-Inverting Differential Input
3Y	11	O	Channel 3 Output
3,4 EN	12	I	Channel 3 and 4 Active High Enable
4Y	13	O	Channel 4 Output
4A	14	I	Channel 4 Non-Inverting Differential Input
4B	15	I	Channel 4 Inverting Differential Input
V <sub>CC</sub>	16	POW	Device Supply

(1) Signal Types: I = Input, O = Output, I/O = Input or Output.

## 5 Specifications

### 5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

			MIN	MAX	UNIT
$V_{CC}$ (see <sup>(2)</sup> )	Supply voltage range		-0.3	6	V
	Voltage range at any bus input (steady state)	A and B	-10	15	V
	Voltage range at any bus input	transient pulse through 100 $\Omega$ , see Figure 6-5	-30	30	V
$V_I$	Voltage input range at 1,2EN and 3,4EN		-0.5	$V_{CC} + 0.5$	V
$I_O$	Receiver output current		$\pm 10$	mA	
	Electrostatic discharge:				
	Continuous power dissipation		See Power Dissipation Rating Table		

- (1) 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.
- (2) All voltage values, except differential I/O bus voltages, are with respect to GND, and are steady-state (unless otherwise specified).

### 5.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$ Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	A and B to GND	$\pm 6000$	V
		All pins	$\pm 5000$	
	Charged device model (CDM), per ANSI/ESDA/JEDEC JS-002 <sup>(2)</sup>	All pins	$\pm 2000$	

- (1) Tested in accordance with JEDEC Standard 22, Test Method A114-A.
- (2) Tested in accordance with JEDEC Standard 22, Test Method C101.

### 5.3 Dissipation Rating Table

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR <sup>(1)</sup> ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING
D	1080 mW	8.7 mW/ $^\circ\text{C}$	690 mW	560 mW
N	1150 mW	9.2 mW/ $^\circ\text{C}$	736 mW	598 mW

- (1) This is the inverse of the junction-to-ambient thermal resistance when board-mounted and with no air flow.

### 5.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		SOIC (D)	PDIP (N)	UNIT
		16 Pins	16 Pins	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	84.6	60.6	$^\circ\text{C}/\text{W}$
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	43.5	48.1	$^\circ\text{C}/\text{W}$
$R_{\theta JB}$	Junction-to-board thermal resistance	43.1	40.6	$^\circ\text{C}/\text{W}$
$\Psi_{JT}$	Junction-to-top characterization parameter	10.4	27.5	$^\circ\text{C}/\text{W}$
$\Psi_{JB}$	Junction-to-board characterization parameter	42.8	40.3	$^\circ\text{C}/\text{W}$
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	N/A	$^\circ\text{C}/\text{W}$

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC package thermal metrics](#) application report.

## 5.5 Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
Supply voltage, $V_{CC}$		4.75	5	5.25	V
Voltage at any bus terminal	A, B	-7		12	V
High-level input voltage, $V_{IH}$	EN	2		$V_{CC}$	V
Low-level input voltage, $V_{IL}$		0		0.8	mA
Output current	Y	-8		8	
Operating free-air temperature, $T_A$	SN75LBC175A	0		70	°C
	SN65LBC175A	-40		85	

## 5.6 Electrical Characteristics

over recommended operating conditions

PARAMETER			TEST CONDITIONS		MIN	TYP <sup>(1)</sup>	MAX	UNIT
V <sub>IT+</sub>	Positive-going differential input voltage threshold		-7 V ≤ V <sub>CM</sub> ≤ 12 V (V <sub>CM</sub> = (V <sub>A</sub> + V <sub>B</sub> ) / 2)		-80		-10	mV
V <sub>IT-</sub>	Negative-going differential input voltage threshold				-200 -120			
V <sub>HYS</sub>	Hysteresis voltage (V <sub>IT+</sub> - V <sub>IT-</sub> )				-40			mV
V <sub>IK</sub>	Input clamp voltage		I <sub>I</sub> = -18 mA		-1.5 -0.8			V
V <sub>OH</sub>	High-level output voltage		V <sub>ID</sub> = 200 mV, I <sub>OH</sub> = -8 mA	See Figure 6-1	2.7 4.8			V
V <sub>OL</sub>	Low-level output voltage		V <sub>ID</sub> = -200 mV, I <sub>OL</sub> = 8 mA		0.2		0.4	
I <sub>OZ</sub>	High-impedance-state output current		V <sub>O</sub> = 0 V to V <sub>CC</sub>		-1		1	μA
I <sub>I</sub>	Line input current		Other input at 0 V, V <sub>CC</sub> = 0 V or 5 V	V <sub>I</sub> = 12 V			0.9	mA
				V <sub>I</sub> = -7 V	-0.7			
I <sub>IH</sub>	High-level input current	Enable inputs					100	μA
I <sub>IL</sub>	Low-level input current				-100			μA
R <sub>I</sub>	Input resistance		A, B		12			kΩ
I <sub>CC</sub>	Supply current		V <sub>ID</sub> = 5 V	1,2EN, 3,4EN at 0 V		20		mA
			No load	1,2EN, 3,4EN at V <sub>CC</sub>		11 16		mA

(1) All typical values are at  $V_{CC} = 5\text{ V}$  and  $25^\circ\text{C}$ .

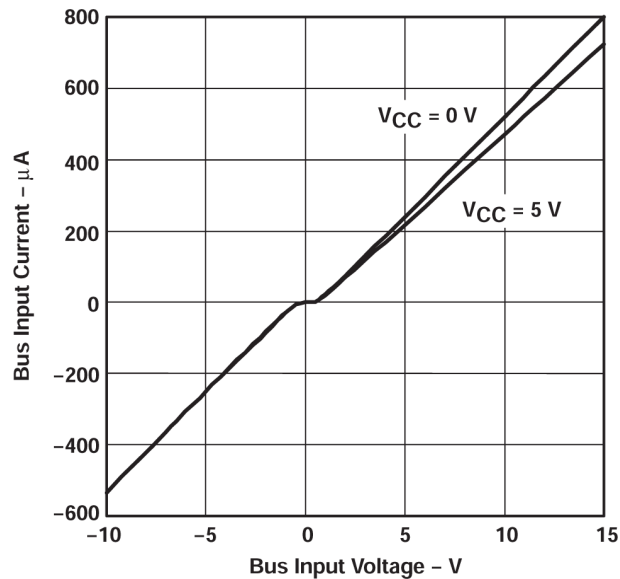
## 5.7 Switching Characteristics

over recommended operating conditions

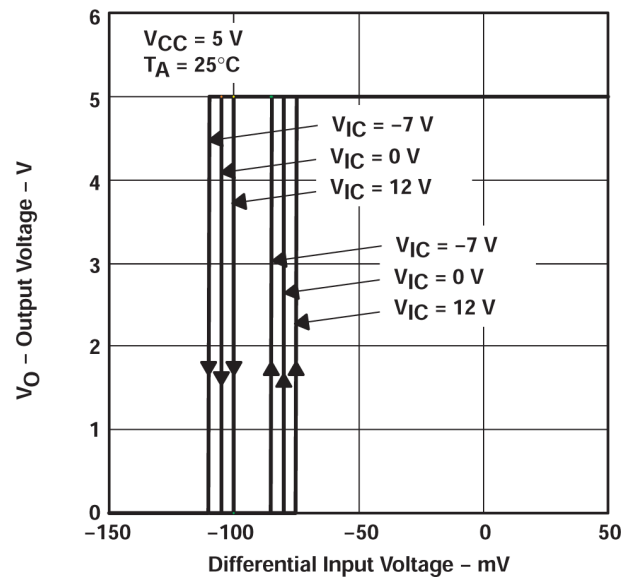
PARAMETER		TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$t_r$	output rise time			2	4	ns
$t_f$	output fall time	$V_{ID} = -3\text{ V to } 3\text{ V}$ , See <a href="#">Figure 6-2</a>		2	4	ns
$t_{PLH}$	Propagation delay time, low-to-high level output			9 12	16	ns
$t_{PHL}$	Propagation delay time, high-to-low level output			9 12	16	ns
$t_{PZH}$	Propagation delay time, high-impedance to high-level output	See <a href="#">Figure 6-3</a>		27	38	ns
$t_{PHZ}$	Propagation delay time, high-level to high-impedance output			7	16	ns
$t_{PZL}$	Propagation delay time, high-impedance to low level output	See <a href="#">Figure 6-4</a>		29	38	ns
$t_{PLZ}$	Propagation delay time, low-level to high-impedance output			12	16	ns
$t_{sk(P)}$	Pulse skew ( $ (t_{PLH} - t_{PHL}) $ )			0.2	1	ns
$t_{sk(O)}$	output skew (see <a href="#">Note 4</a> )				2	ns
$t_{sk(PP)}$	Part-to-part skew (see <a href="#">Note 5</a> )				2	ns

- (1) All typical values are at  $V_{CC} = 5\text{ V}$  and  $25^\circ\text{C}$ .
- (2) Outputs skew ( $t_{sk(O)}$ ) is the magnitude of the time delay difference between the outputs of a single device with all of the inputs connected together.
- (3) Part-to-part skew ( $t_{sk(PP)}$ ) is the magnitude of the difference in propagation delay times between any specified terminals of two devices when both devices operate with the same input signals, the same supply voltages, at the same temperature, and have identical packages and test circuits.

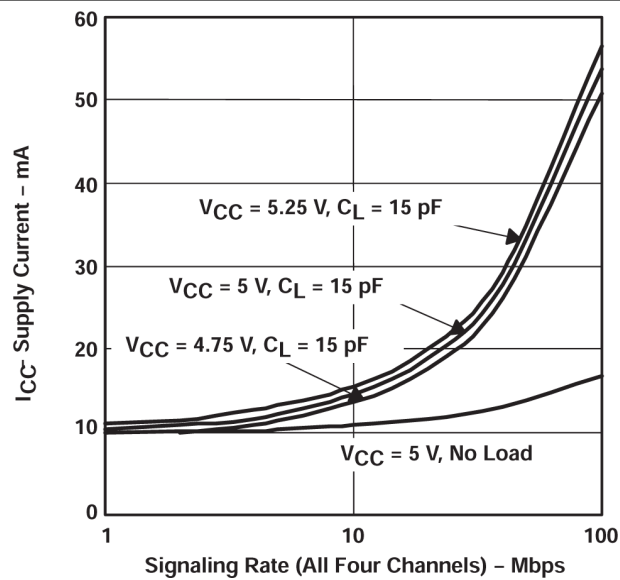
## 5.8 Typical Characteristics



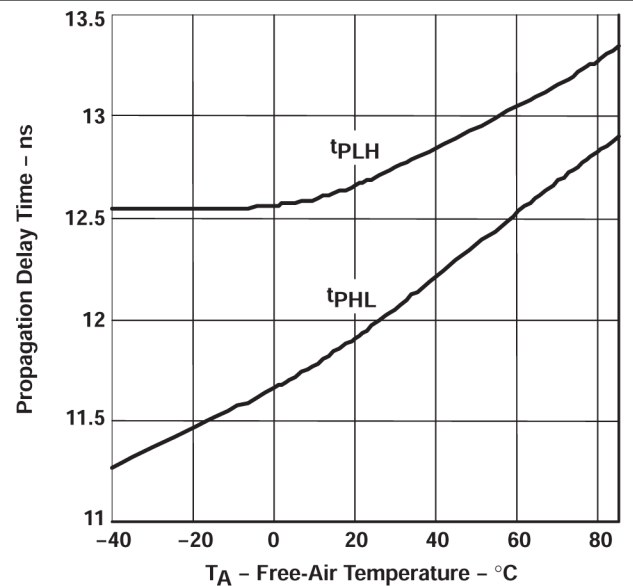
**Figure 5-1. Bus Input Current vs Bus Input Voltage**



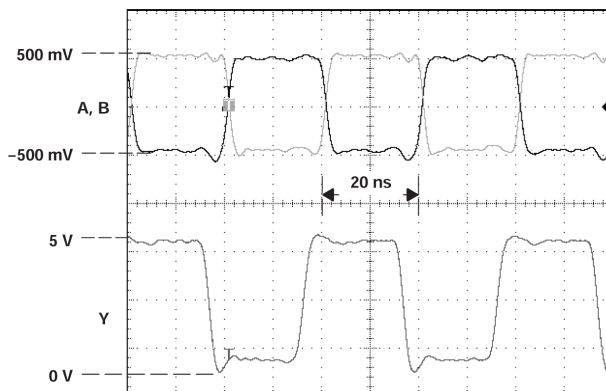
**Figure 5-2. Output Voltage vs Differential Input Voltage**



**Figure 5-3. Supply Current vs Signaling Rate (All Four Channels)**



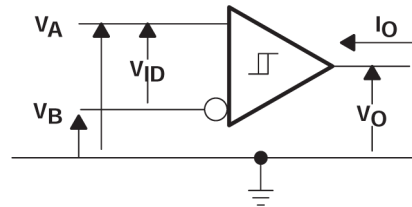
**Figure 5-4. Propagation Delay Time vs Free-air Temperature**



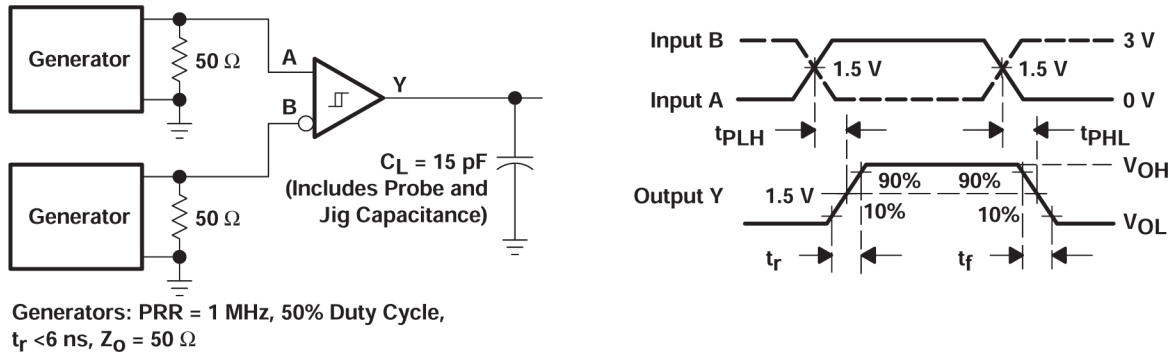
**Figure 5-5. Receiver Inputs and Outputs, 50 Mbps Signaling Rate**



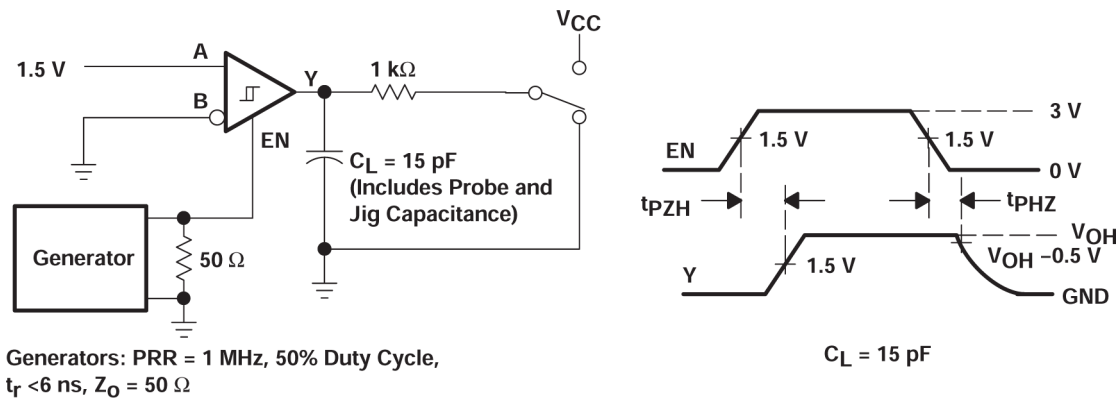
## 6 Parameter Measurement Information



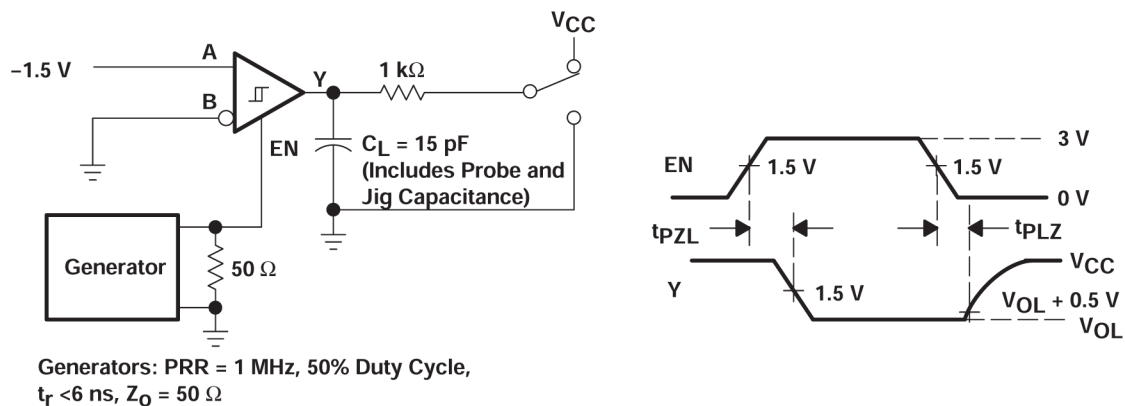
**Figure 6-1. Voltage and Current Definitions**



**Figure 6-2. Switching Test Circuit and Waveforms**



**Figure 6-3. Test Circuit Waveforms,  $t_{PZH}$  and  $t_{PHZ}$**



**Figure 6-4. Test Circuit Waveforms,  $t_{PZL}$  and  $t_{PLZ}$**

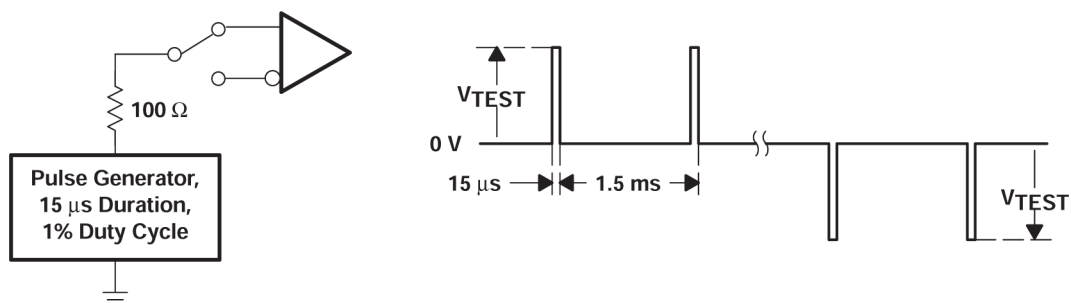


Figure 6-5. Test Circuit and Waveform, Transient Over-Voltage Test

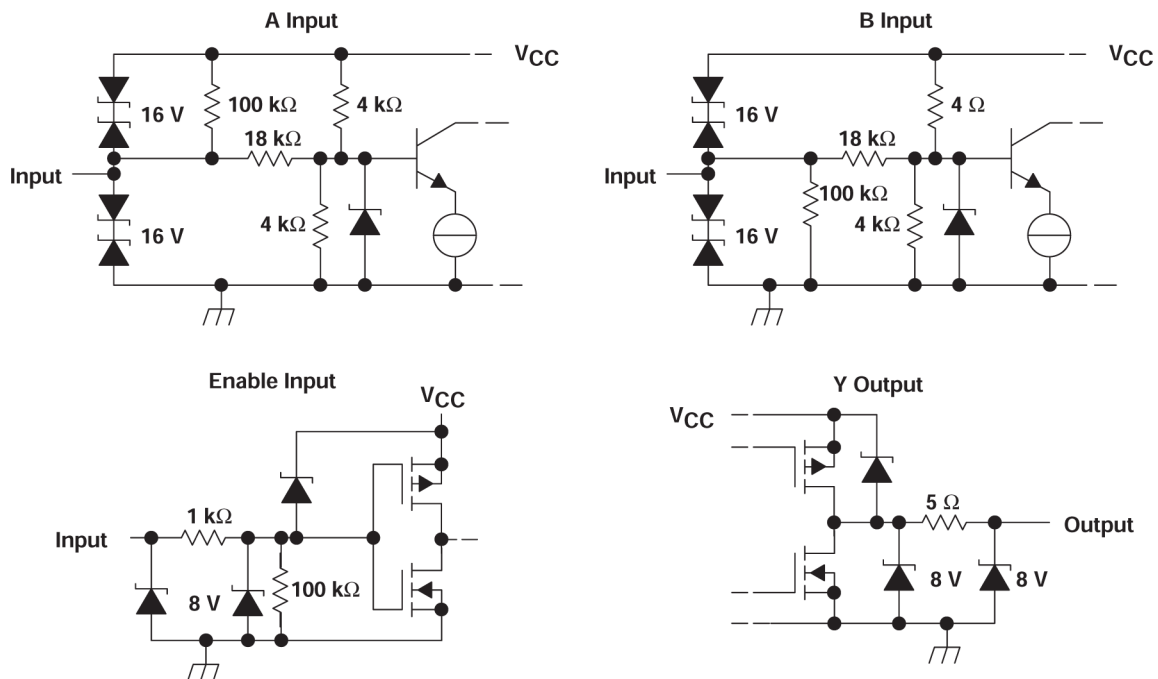
## 7 Detailed Description

### 7.1 Device Functional Modes

**Table 7-1. Functional Table (Each Receiver)**

DIFFERENTIAL INPUTS A – B ( $V_{ID}$ )	ENABLE EN <sup>(1)</sup>	OUTPUT Y
$V_{ID} \leq -0.2$ V	H	L
$-0.2$ V $< V_{ID} < -0.01$ V	H	?
$-0.01$ V $\leq V_{ID}$	H	H
X	L	Z
X	OPEN	Z
Short circuit	H	H
Open circuit	H	H

(1) H = high level, L = low level, X = irrelevant, Z = high impedance (off), ? = indeterminate



**Figure 7-1. Equivalent Input and Output Schematic Diagrams**

## 8 Application and Implementation

### Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

### 8.1 Typical Application

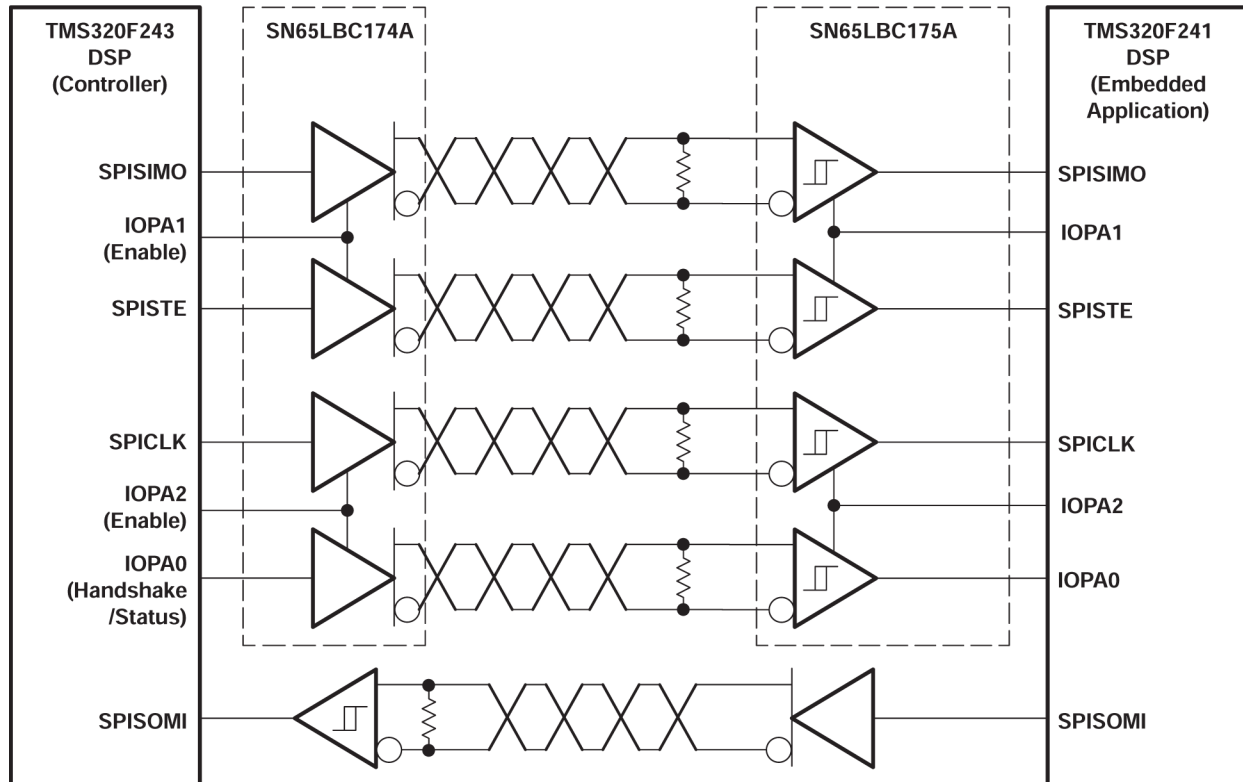
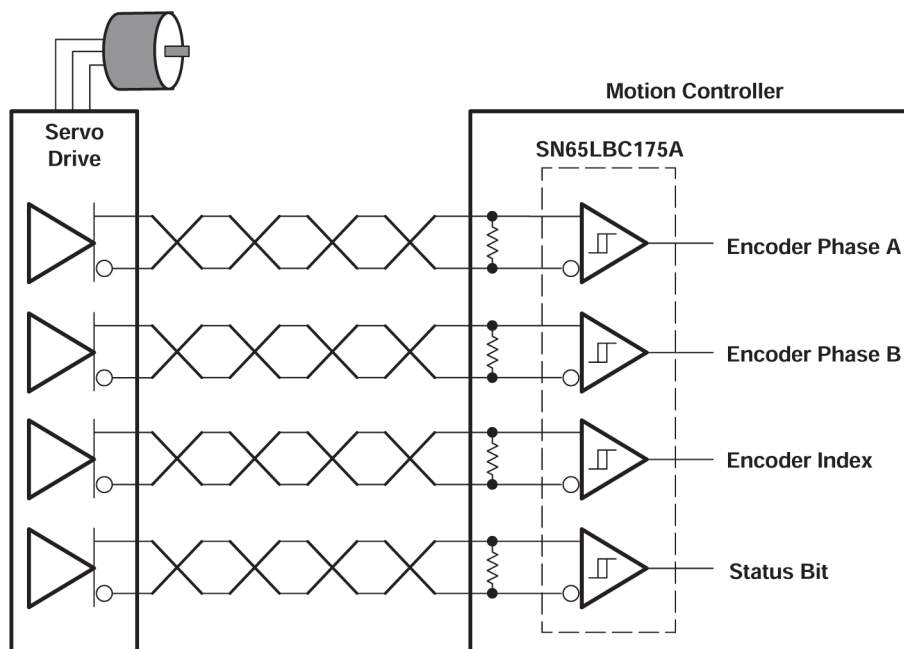


Figure 8-1. Typical Application Circuit, DSP-to-DSP Link via Serial Peripheral Interface



**Figure 8-2. Typical Application Circuit, High-Speed Servomotor Encoder Interface**

## 9 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

### 9.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](http://ti.com). Click on *Subscribe to updates* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 9.2 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

### 9.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

### 9.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 9.5 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 10 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision C (March 2009) to Revision D (November 2023)	Page
• Changed the numbering format for tables, figures, and cross-references throughout the document.....	1

## 11 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

## PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">SN65LBC175AD</a>	Obsolete	Production	SOIC (D)   16	-	-	Call TI	Call TI	-40 to 85	65LBC175A
<a href="#">SN65LBC175ADR</a>	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	65LBC175A
SN65LBC175ADR.A	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	65LBC175A
SN65LBC175ADRG4	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	65LBC175A
SN65LBC175ADRG4.A	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	65LBC175A
<a href="#">SN65LBC175AN</a>	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	65LBC175A
SN65LBC175AN.A	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	65LBC175A
<a href="#">SN75LBC175AD</a>	Obsolete	Production	SOIC (D)   16	-	-	Call TI	Call TI	0 to 70	75LBC175A
<a href="#">SN75LBC175ADR</a>	Obsolete	Production	SOIC (D)   16	-	-	Call TI	Call TI	0 to 70	75LBC175A
<a href="#">SN75LBC175AN</a>	Obsolete	Production	PDIP (N)   16	-	-	Call TI	Call TI	0 to 70	75LBC175A

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

**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.

**OTHER QUALIFIED VERSIONS OF SN65LBC175A :**

- Enhanced Product : [SN65LBC175A-EP](#)

NOTE: Qualified Version Definitions:

- Enhanced Product - Supports Defense, Aerospace and Medical Applications



## 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
SN65LBC175ADR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN65LBC175ADRG4	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65LBC175ADR	SOIC	D	16	2500	340.5	336.1	32.0
SN65LBC175ADRG4	SOIC	D	16	2500	353.0	353.0	32.0

## TUBE



\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN65LBC175AN	N	PDIP	16	25	506	13.97	11230	4.32
SN65LBC175AN.A	N	PDIP	16	25	506	13.97	11230	4.32

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.

N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



4040049/E 12/2002

NOTES:

- A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).  
 The 20 pin end lead shoulder width is a vendor option, either half or full width.

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