## **SN65LBC175A, SN75LBC175A QUADRUPLE RS-485 DIFFERENTIAL LINE RECEIVERS**

SLLS455C - NOVEMBER 2000 - REVISED MARCH 2009

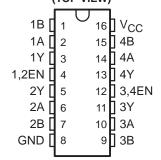
- Designed for TIA/EIA-485, TIA/EIA-422, and ISO 8482 Applications
- Signaling Rate<sup>1</sup> Exceeding 50 Mbps
- Fail-Safe in Bus Short-Circuit, Open-Circuit, and Idle-Bus Conditions
- ESD Protection on Bus Inputs 6 kV
- Common-Mode Bus Input Range -7 V to 12 V
- Propagation Delay Times <16 ns
- Low Standby Power Consumption <20 μA
- Pin-Compatible Upgrade for MC3486. DS96F175, LTC489, and SN75175

#### description

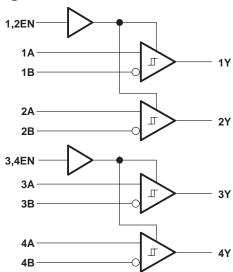
The SN65LBC175A and SN75LBC175A are quadruple differential line receivers with 3-state outputs, designed for TIA/EIA-485 (RS-485), TIA/EIA-422 (RS-422), and ISO 8482 (Euro RS-485) applications.

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.

SN65LBC175A (Marked as 65LBC175A) SN75LBC175A (Marked as 75LBC175A) D or N PACKAGE (TOP VIEW)



#### logic diagram



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°C to 70°C. The SN65LBC175A is characterized over the temperature range 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.

LinBiCMOS is a trademark of Texas Instruments.

<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).



#### **FUNCTION TABLE** (each receiver)

DIFFERENTIAL INPUTS A – B (V <sub>ID</sub> )	ENABLE EN	OUTPUT Y
V <sub>ID</sub> ≤ -0.2 V	Н	L
-0.2 V < V <sub>ID</sub> < -0.01 V	Н	?
-0.01 V ≤ V <sub>ID</sub>	Н	Η
Х	L	Z
Х	OPEN	Z
Short circuit	Н	Н
Open circuit	Н	Н

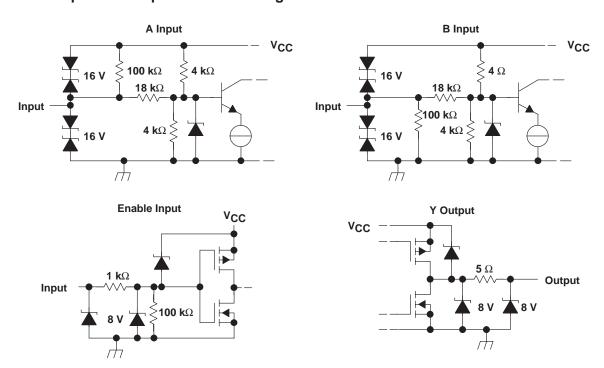
H = high level, L = low level, X = irrelevant, Z = high impedance (off), ? = indeterminate

#### **AVAILABLE OPTIONS**

	PACH	(AGE
TA	PLASTIC SMALL OUTLINE <sup>†</sup> (JEDEC MS-012)	PLASTIC DUAL-IN-LINE (JEDEC MS-001)
0°C to 70°C	SN75LBC175AD	SN75LBC175AN
-40°C to 85°C	SN65LBC175AD	SN65LBC175AN

<sup>†</sup> Add an R suffix for taped and reeled

## equivalent input and output schematic diagrams





<sup>†</sup> For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.

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## absolute maximum ratings<sup>†</sup> over operating free-air temperature range (unless otherwise noted)

Supply voltage range, V <sub>CC</sub> (see Note 1) Voltage range at any bus input (steady sta Voltage range at any bus input (transient p Voltage input range at 1,2EN and 3,4EN, \	te), A and B $$	
Receiver output current, I <sub>O</sub>	•	00
Electrostatic discharge:		
Human body model (see Note 2):	A and B to GND	6 kV
	All pins	5 kV
Charged-device model (see Note 3):	All pins	2 kV
Continuous power dissipation		

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

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

#### DISSIPATION RATING TABLE

PACKAGE	$T_{\mbox{A}} \le 25^{\circ}\mbox{C}$ POWER RATING	DERATING FACTOR† ABOVE T <sub>A</sub> = 25°C	T <sub>A</sub> = 70°C POWER RATING	T <sub>A</sub> = 85°C POWER RATING
D	1080 mW	8.7 mW/°C	690 mW	560 mW
N	1150 mW	9.2 mW/°C	736 mW	598 mW

<sup>†</sup> This is the inverse of the junction-to-ambient thermal resistance when board-mounted and with no air flow.

#### recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V <sub>CC</sub>		4.75	5	5.25	V
Voltage at any bus terminal	A, B	-7		12	V
High-level input voltage, V <sub>IH</sub>	EN	2		VCC	
Low-level input voltage, V <sub>IL</sub>	EN	0		8.0	V
Output current	Υ	-8		8	mA
	SN75LBC175A	0		70	
Operating free-air temperature, T <sub>A</sub>	SN65LBC175A	-40		85	°C

## SN65LBC175A, SN75LBC175A QUADRUPLE RS-485 DIFFERENTIAL LINE RECEIVERS

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### electrical characteristics over recommended operating conditions

PARAMETER			TEST C	ONDITIONS	MIN	TYP <sup>†</sup>	MAX	UNIT
V <sub>IT+</sub>	Positive-going differential	input voltage threshold				-80	-10	
VIT-	Negative-going differentia threshold	l input voltage	$-7 \text{ V} \leq \text{V}_{CM} \leq 12 \text{ V}$ (	$V_{CM} = (V_A + V_B) / 2)$	-200	-120		mV
V <sub>HYS</sub>	Hysteresis voltage (V <sub>IT+</sub>	– ∨ <sub>IT</sub> _)				-40		mV
VIK	Input clamp voltage		I <sub>I</sub> = -18 mA		-1.5	-0.8		V
VOH	High-level output voltage	el output voltage		V <sub>ID</sub> = 200 mV, I <sub>OH</sub> = -8 mA		4.8		.,
VOL	Low-level output voltage		$V_{ID} = -200 \text{ mV},$ $I_{OL} = 8 \text{ mA}$	See Figure 1		0.2	0.4	V
loz	High-impedance-state ou	tput current	$V_O = 0 V \text{ to } V_{CC}$		-1		1	μΑ
1 <sub>1</sub>	Line input current		Other input at 0 V, V <sub>CC</sub> = 0 V or 5 V	V <sub>I</sub> = 12 V V <sub>I</sub> = -7 V	-0.7		0.9	mA
lн	High-level input current			•			100	μΑ
I <sub>IL</sub>	Low-level input current	Enable inputs			-100			μΑ
R <sub>I</sub>	Input resistance		A, B		12			kΩ
	0		V <sub>ID</sub> = 5 V	1,2EN, 3,4EN at 0 V			20	mA
ICC	Supply current		No load	1,2EN, 3,4EN at V <sub>CC</sub>		11	16	mA

<sup>&</sup>lt;sup>†</sup> All typical values are at  $V_{CC} = 5 \text{ V}$  and  $25^{\circ}\text{C}$ .

## switching characteristics over recommended operating conditions

	PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
t <sub>r</sub>	Output rise time			2	4	ns
tf	Output fall time			2	4	ns
<sup>t</sup> PLH	Propagation delay time, low-to-high level output	$V_{ID} = -3 \text{ V to } 3 \text{ V, See Figure } 2$	9	12	16	ns
<sup>t</sup> PHL	Propagation delay time, high-to-low level output		9	12	16	ns
<sup>t</sup> PZH	Propagation delay time, high-impedance to high-level output	0		27	38	ns
<sup>t</sup> PHZ	Propagation delay time, high-level to high-impedance output	See Figure 3		7	16	ns
t <sub>PZL</sub>	Propagation delay time, high-impedance to low level output	Con Figure 4		29	38	ns
<sup>t</sup> PLZ	Propagation delay time, low-level to high-impedance output	See Figure 4		12	16	ns
tsk(p)	Pulse skew (  (tpLH - tpHL)  )			0.2	1	ns
tsk(o)	Output skew (see Note 4)				2	ns
tsk(pp)	Part-to-part skew (see Note 5)				2	ns

<sup>&</sup>lt;sup>†</sup> All typical values are at  $V_{CC} = 5 \text{ V}$  and 25°C.

NOTES: 4. Outputs skew (t<sub>Sk(O)</sub>) is the magnitude of the time delay difference between the outputs of a single device with all of the inputs connected together.



<sup>5.</sup> Part-to-part skew (t<sub>Sk(pp)</sub>) 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.

#### PARAMETER MEASUREMENT INFORMATION

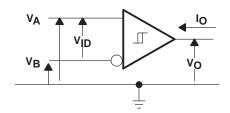


Figure 1. Voltage and Current Definitions

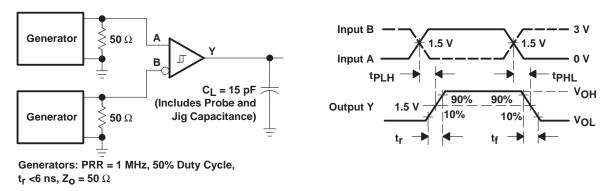


Figure 2. Switching Test Circuit and Waveforms

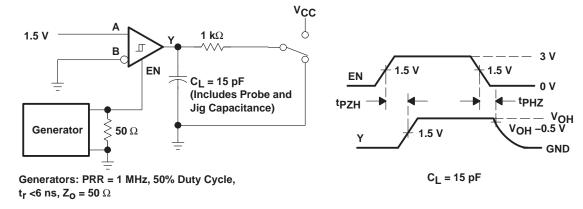
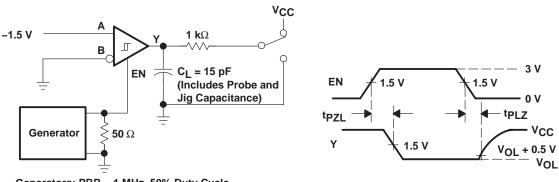


Figure 3. Test Circuit Waveforms, tpZH and tpHZ

#### PARAMETER MEASUREMENT INFORMATION



Generators: PRR = 1 MHz, 50% Duty Cycle,  $t_{r}$  <6 ns,  $\rm Z_{O}$  = 50  $\rm \Omega$ 

Figure 4. Test Circuit Waveforms, tpzL and tpLZ

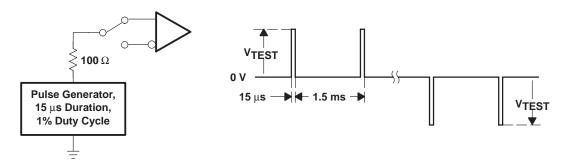
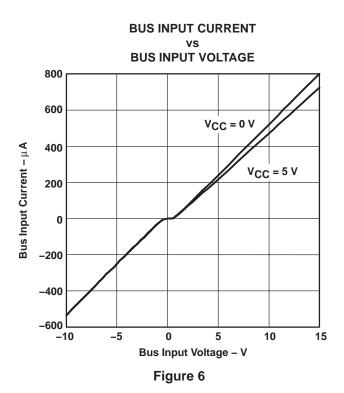
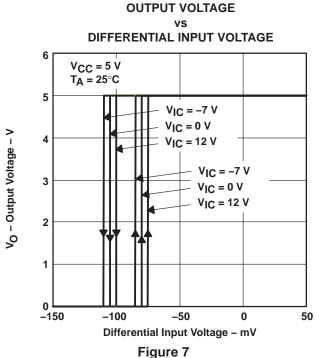
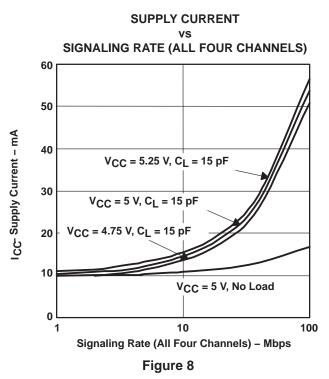


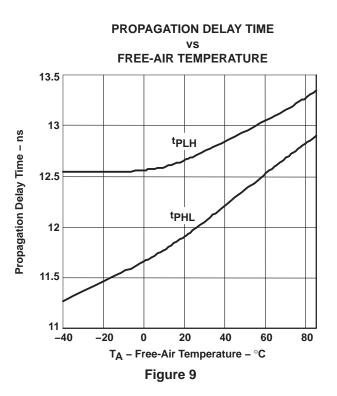
Figure 5. Test Circuit and Waveform, Transient Over-Voltage Test

#### **TYPICAL CHARACTERISTICS**









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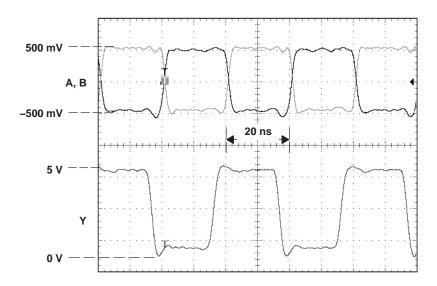


Figure 10. Receiver Inputs and Outputs, 50 Mbps Signaling Rate

#### **APPLICATION INFORMATION**

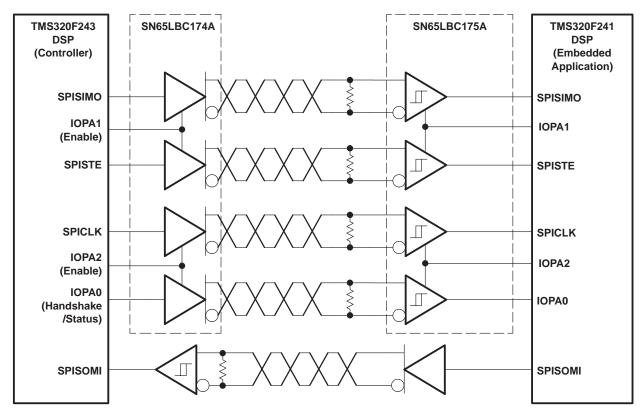


Figure 11. Typical Application Circuit, DSP-to-DSP Link via Serial Peripheral Interface

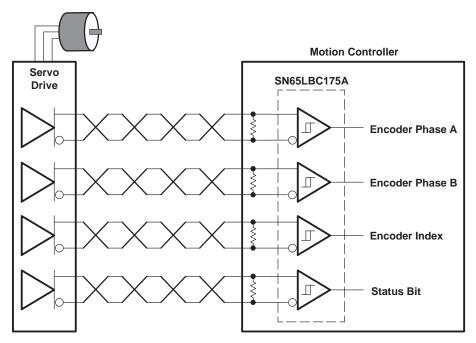


Figure 12. Typical Application Circuit, High-Speed Servomotor Encoder Interface



#### PACKAGE OPTION ADDENDUM



ti.com 10-Mar-2009

#### **PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Packag Qty	e Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN65LBC175AD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC175ADG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC175ADR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC175ADRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC175AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN65LBC175ANE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75LBC175AD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC175ADG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC175ADR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC175ADRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC175AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75LBC175ANE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	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.

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# **PACKAGE OPTION ADDENDUM**

10-Mar-2009

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#### TAPE AND REEL INFORMATION





	Α0	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
Г	P1	Pitch between successive cavity centers

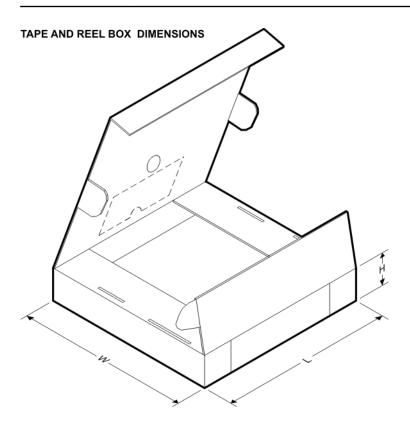
## QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



#### \*All dimensions are nominal

Device	Package Type	Package Drawing			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
SN75LBC175ADR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1





#### \*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65LBC175ADR	SOIC	D	16	2500	333.2	345.9	28.6
SN75LBC175ADR	SOIC	D	16	2500	333.2	345.9	28.6

# D (R-PDS0-G16)

## PLASTIC SMALL OUTLINE



NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- 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.
- 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.



# D (R-PDSO-G16)

# PLASTIC SMALL OUTLINE



NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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