

## DIFFERENTIAL BUS TRANSCEIVER

### FEATURES

- **One-Fourth Unit Load Allows up to 128 Devices on a Bus**
- **ESD Protection for Bus Terminals:**
  - $\pm 15$ -kV Human Body Model
  - $\pm 8$ -kV IEC61000-4-2, Contact Discharge
  - $\pm 15$ -kV IEC61000-4-2, Air-Gap Discharge
- **Meets or Exceeds the Requirements of ANSI Standard TIA/EIA-485-A and ISO 8482: 1987(E)**
- **Controlled Driver Output-Voltage Slew Rates Allow Longer Cable Stub Lengths**
- **Designed for Signaling Rates† Up to 250-kbps**
- **Low Disabled Supply Current . . . 250  $\mu$ A Max**
- **Thermal Shutdown Protection**
- **Open-Circuit Fail-Safe Receiver Design**
- **Receiver Input Hysteresis . . . 70 mV Typ**
- **Glitch-Free Power-Up and Power-Down Protection**

### APPLICATIONS

- **Utility Meters**
- **Industrial Process Control**
- **Building Automation**

### DESCRIPTION

The SN65LBC182 and SN75LBC182 are differential data line transceivers with a high level of ESD protection in the trade-standard footprint of the SN75176. They are designed for balanced transmission lines and meet ANSI standard TIA/EIA-485-A and ISO 8482. The SN65LBC182 and SN75LBC182 combine a 3-state, differential line driver and differential input line receiver, both of which operate from a single 5-V power supply. The driver and receiver have active-high and active-low enables, respectively, which can be externally connected together to function as a direction control.

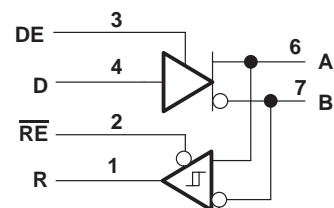
The driver outputs and the receiver inputs connect internally to form a differential input/output (I/O) bus port that is designed to offer minimum loading to the bus. This port operates over a wide range of common-mode voltage, making the device suitable for party-line applications. The device also includes additional features for party-line data buses in electrically noisy environment applications such as industrial process control or power inverters.

The SN75LBC182 and SN65LBC182 bus pins also exhibit a high input resistance equivalent to one-fourth unit load allowing connection of up to 128 similar devices on the bus. The high ESD tolerance protects the device for cabled connections. (For an even higher level of protection, see the SN65/75LBC184, literature number SLLS236.)

The differential driver design incorporates slew-rate-controlled outputs sufficient to transmit data up to 250 kbps. Slew-rate control allows longer unterminated cable runs and longer stub lengths from the main backbone than possible with uncontrolled voltage transitions. The receiver design provides a fail-safe output of a high level when the inputs are left floating (open circuit). Very low device supply current can be achieved by disabling the driver and the receiver.

The SN65LBC182 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , and the SN75LBC182 is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

### functional block diagram



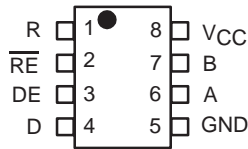
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

†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).

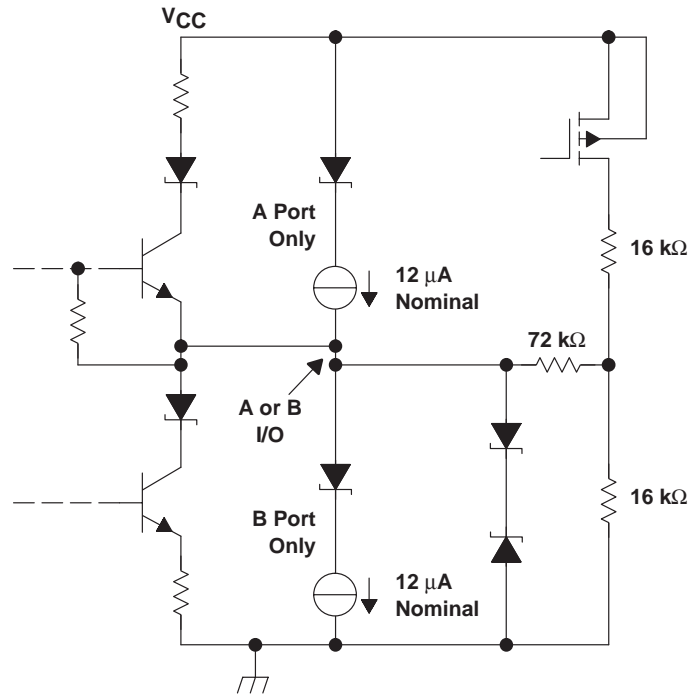
# SN65LBC182 SN75LBC182

SLLS500A – MAY 2001 – REVISED MARCH 2005

SN65LBC182D (Marked as 6LB182)  
 SN75LBC182D (Marked as 7LB182)  
 SN65LBC182P (Marked as 65LBC182)  
 SN75LBC182P (Marked as 75LBC182)  
 (TOP VIEW)



## schematic of inputs and outputs



## Function Tables

### DRIVER

INPUT D	ENABLE DE	OUTPUTS	
		A	B
H	H	H	L
L	H	L	H
X	L	Z	Z
Open	H	H	L

### RECEIVER

DIFFERENTIAL INPUTS	ENABLE RE	OUTPUT R
$V_{ID} \geq 0.2 \text{ V}$	L	H
$-0.2 \text{ V} < V_{ID} < 0.2 \text{ V}$	L	?
$V_{ID} \leq -0.2 \text{ V}$	L	L
X	H	Z
Open	L	H

### AVAILABLE OPTIONS

T <sub>A</sub>	PACKAGE	
	PLASTIC SMALL-OUTLINE† (JEDEC MS-012)	PLASTIC DUAL-IN-LINE PACKAGE (JEDEC MS-001)
0°C to 70°C	SN75LBC182D	SN75LBC182P
-40°C to 85°C	SN65LBC182D	SN65LBC182P

† Add R suffix for taped and reel.

† 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](http://www.ti.com).



**driver electrical characteristics over recommended operating conditions**

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V <sub>IK</sub>	Input clamp voltage	I <sub>I</sub> = -18 mA	-1.5			V
V <sub>O</sub>	Output voltage	I <sub>O</sub> = 0	0		V <sub>CC</sub>	V
V <sub>OD</sub>	Differential output voltage	R <sub>L</sub> = 54 Ω, See Figure 1	1.5	2.2	V <sub>CC</sub>	V
		V <sub>test</sub> = -7 V to 12 V, See Figure 2	1.5	2.2	V <sub>CC</sub>	V
ΔV <sub>OD</sub>	Change in magnitude of differential output voltage	See Figure 1	-0.2		0.2	V
V <sub>OC(SS)</sub>	Steady-state common-mode output voltage		1		3	
ΔV <sub>OC(SS)</sub>	Change in steady-state common-mode output voltage	See Figures 1 and 4	-0.2		0.2	
V <sub>OC(PP)</sub>	Peak-to-peak change in common-mode output voltage during state transitions		0.8			V
I <sub>OZ</sub>	High-impedance output current	See receiver input currents				
I <sub>IH</sub>	High-level input current (D, DE)	V <sub>I</sub> = 2.4 V			50	μA
I <sub>IL</sub>	Low-level input current (D, DE)	V <sub>I</sub> = 0.4 V	-50			μA
I <sub>OS</sub>	Short-circuit output current	V <sub>O</sub> = -7 V to 12 V	-250		250	mA
I <sub>CC</sub>	Supply current	SN75LBC182	No load, DE at V <sub>CC</sub> , $\overline{RE}$ at V <sub>CC</sub>	12	25	mA
		SN65LBC182		12	30	

† All typical values are at V<sub>CC</sub> = 5 V and T<sub>A</sub> = 25°C.

**driver switching characteristics over recommended operating conditions (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t <sub>r</sub>	Differential output signal rise time	R <sub>L</sub> = 54 Ω, C <sub>L</sub> = 50 pF, See Figure 3	0.25	0.72	1.2	μs
t <sub>f</sub>	Differential output signal fall time		0.25	0.73	1.2	
t <sub>PLH</sub>	Propagation delay time, low-to-high-level output				1.3	
t <sub>PHL</sub>	Propagation delay time, high-to-low-level output				1.3	
t <sub>sk(p)</sub>	Pulse skew (t <sub>PHL</sub> - t <sub>PLH</sub> )			0.075	0.15	
t <sub>PZH</sub>	Output enable time to high level	R <sub>L</sub> = 110 Ω, See Figure 5			3.5	μs
t <sub>PHZ</sub>	Output disable time from high level				3.5	
t <sub>PZL</sub>	Output enable time to low level	R <sub>L</sub> = 110 Ω, See Figure 6			3.5	μs
t <sub>PLZ</sub>	Output disable time from low level				3.5	

**receiver electrical characteristics over recommended operating conditions (unless otherwise noted)**

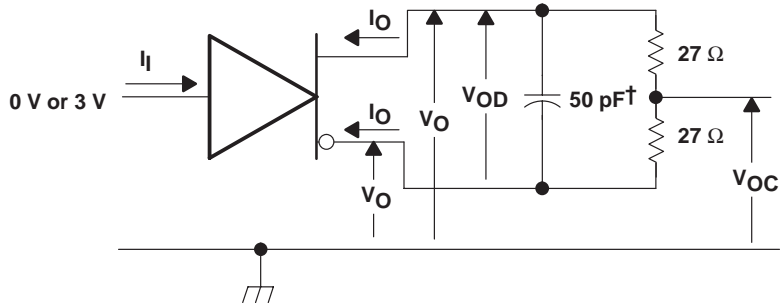
PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
$V_{IT+}$	Positive-going input threshold voltage				0.2	V
$V_{IT-}$	Negative-going input threshold voltage		-0.2			
$V_{hys}$	Hysteresis voltage ( $V_{IT+} - V_{IT-}$ )			70		mV
$V_{IK}$	Enable-input clamp voltage	$I_I = -18$ mA	-1.5			V
$V_{OH}$	High-level output voltage	$V_{ID} = 200$ mV, $I_O = -8$ mA, See Figure 7	2.8			V
$V_{OL}$	Low-level output voltage	$V_{ID} = 200$ mV, $I_O = 4$ mA, See Figure 7			0.4	V
$I_{OZ}$	High-impedance-state output current	$V_O = 0.4$ to $2.4$ V			$\pm 1$	$\mu$ A
$I_I$	Bus input current	$V_{IH} = 12$ V, $V_{CC} = 5$ V	Other input at 0 V		250	$\mu$ A
		$V_{IH} = 12$ V, $V_{CC} = 0$ V		250		
		$V_{IH} = -7$ V, $V_{CC} = 5$ V		-200		
		$V_{IH} = -7$ V, $V_{CC} = 0$ V		-200		
$I_{IH}$	High-level input current ( $\overline{RE}$ )	$V_{IH} = 2$ V			50	$\mu$ A
$I_{IL}$	Low-level input current ( $\overline{RE}$ )	$V_{IL} = 0.8$ V	-50			$\mu$ A
$I_{CC}$	Supply current	No load	DE at 0 V, $\overline{RE}$ at 0 V		3.5	mA
			DE at 0 V, $\overline{RE}$ at $V_{CC}$	175	250	$\mu$ A

† All typical values are at  $V_{CC} = 5$  V and  $T_A = 25^\circ$ C.

**receiver switching characteristics over recommended operating conditions (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_r$	Differential output signal rise time	$C_L = 50$ pF, See Figure 7		20		ns
$t_f$	Differential output signal fall time			20		
$t_{PLH}$	Propagation delay time, low-to-high-level output				150	
$t_{PHL}$	Propagation delay time, high-to-low-level output				150	
$t_{PZH}$	Output enable time to high level	See Figure 8		100		ns
$t_{PZL}$	Output enable time to low level			100		
$t_{PHZ}$	Output disable time from high level				100	ns
$t_{PLZ}$	Output disable time from low level				100	
$t_{sk(p)}$	Pulse skew $ t_{PHL} - t_{PLH} $			50	ns	

PARAMETER MEASUREMENT INFORMATION



†Includes probe and jig capacitance

Figure 1. Driver Test Circuit,  $V_{OD}$  and  $V_{OC}$  Without Common-Mode Loading

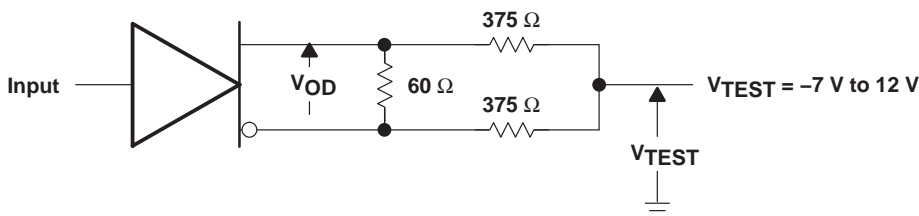
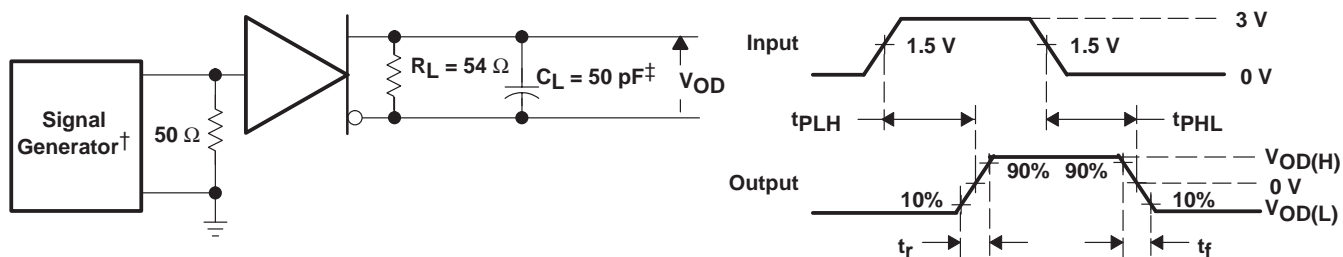


Figure 2. Driver Test Circuit,  $V_{OD}$  With Common-Mode Loading



†PRR = 1 MHz, 50% duty cycle,  $t_r < 6$  ns,  $t_f < 6$  ns,  $Z_0 = 50 \Omega$

‡Includes probe and jig capacitance

Figure 3. Driver Switching Test Circuit and Waveforms

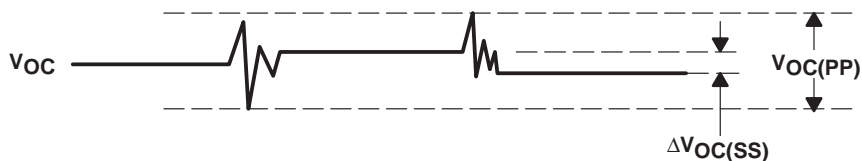
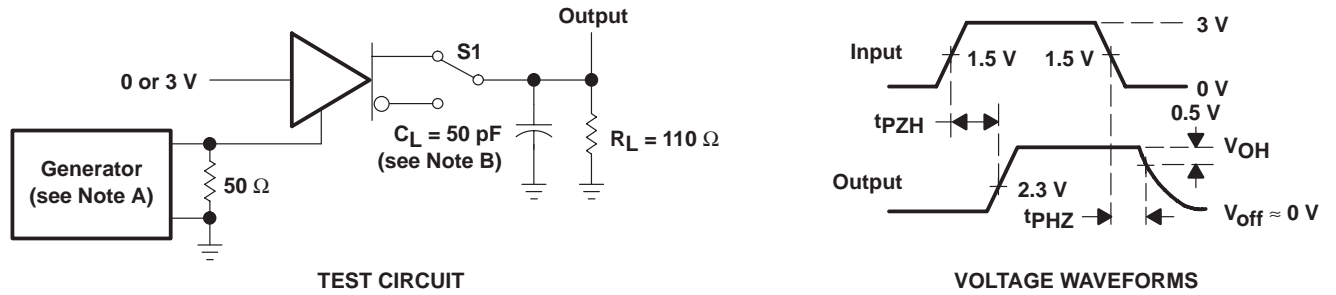


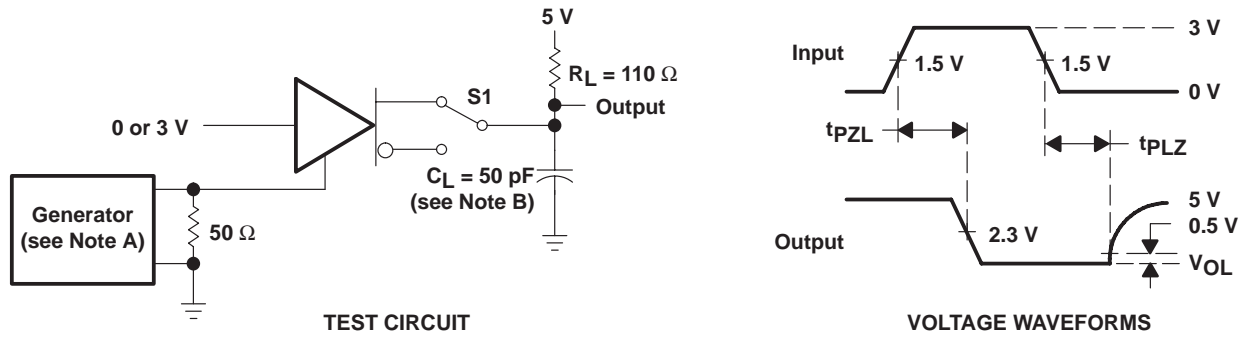
Figure 4.  $V_{OC}$  Definitions

PARAMETER MEASUREMENT INFORMATION



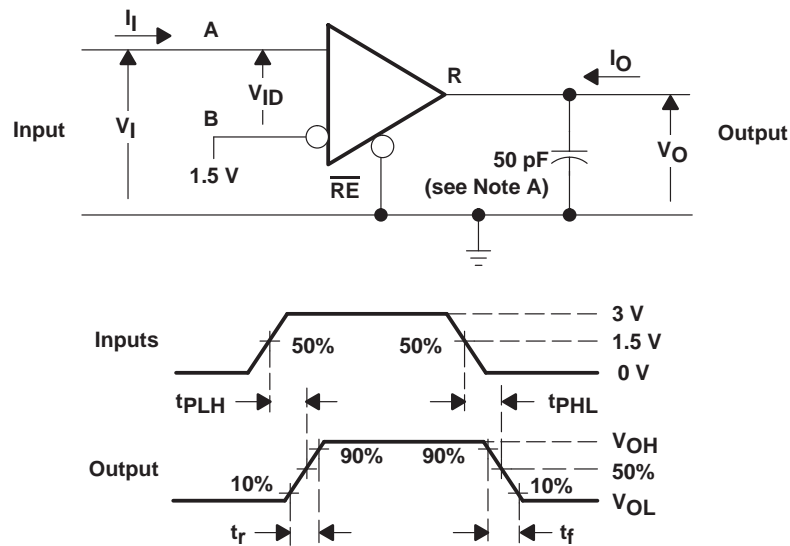
NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR = 1.25 kHz, 50% duty cycle,  $t_r \leq 10$  ns,  $t_f \leq 10$  ns,  $Z_O = 50 \Omega$ .  
B.  $C_L$  includes probe and jig capacitance.

Figure 5. Driver  $t_{pZH}$  and  $t_{pHZ}$  Test Circuit and Voltage Waveforms



NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR = 1.25 kHz, 50% duty cycle,  $t_r \leq 10$  ns,  $t_f \leq 10$  ns,  $Z_O = 50 \Omega$ .  
B.  $C_L$  includes probe and jig capacitance.

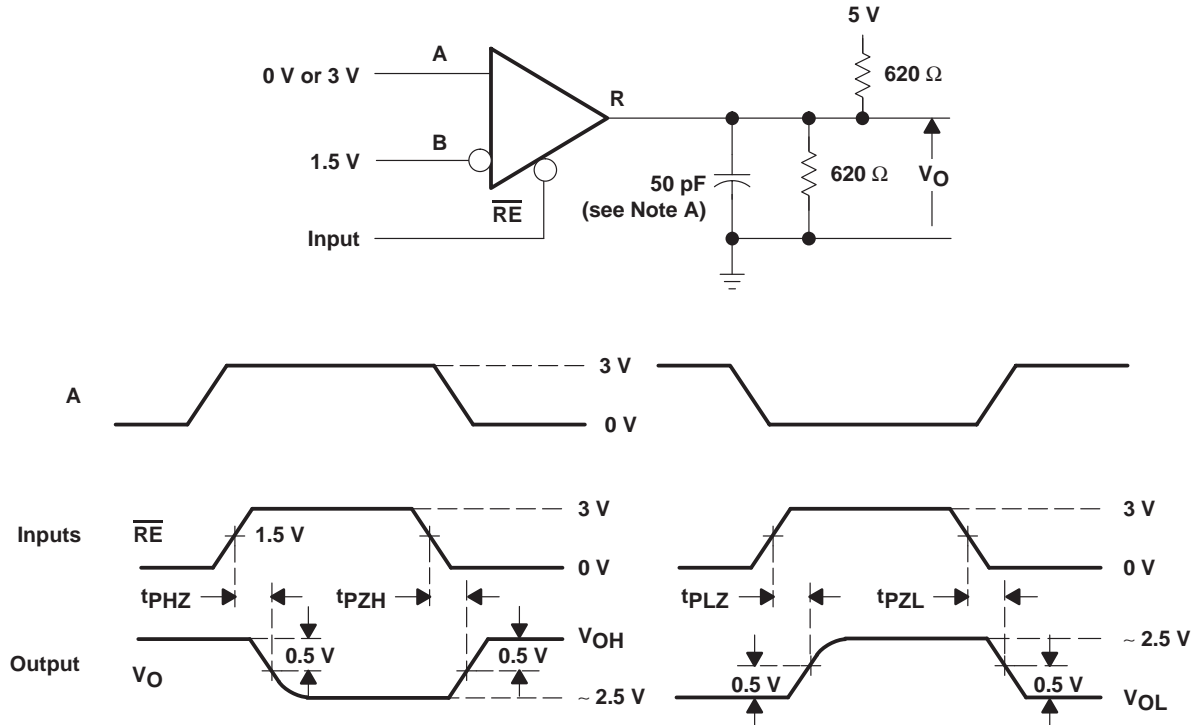
Figure 6. Driver  $t_{pZL}$  and  $t_{pLZ}$  Test Circuit and Voltage Waveforms



NOTE A: This value includes probe and jig capacitance ( $\pm 10\%$ ).

Figure 7. Receiver  $t_{PLH}$  and  $t_{PHL}$  Test Circuit and Voltage Waveforms

**PARAMETER MEASUREMENT INFORMATION**



NOTE A: This value includes probe and jig capacitance ( $\pm 10\%$ ).

**Figure 8. Receiver  $t_{PZL}$ ,  $t_{PLZ}$ ,  $t_{PZH}$ , and  $t_{PHZ}$  Test Circuit and Voltage Waveforms**



TYPICAL CHARACTERISTICS

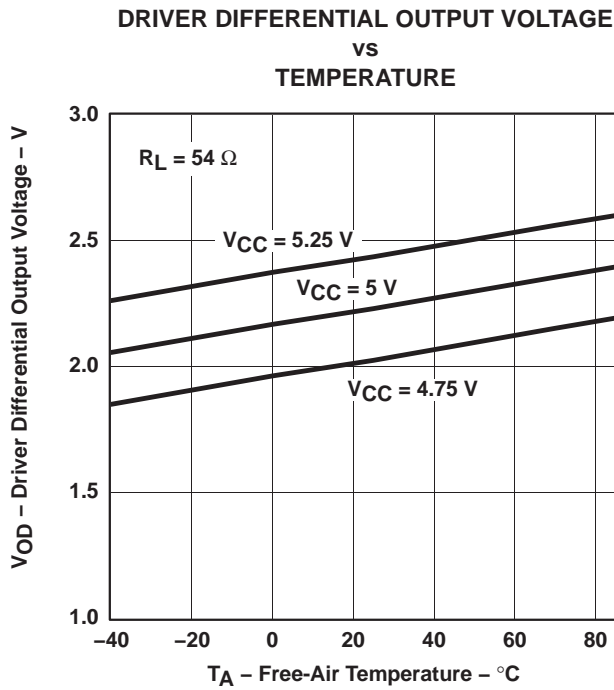


Figure 9

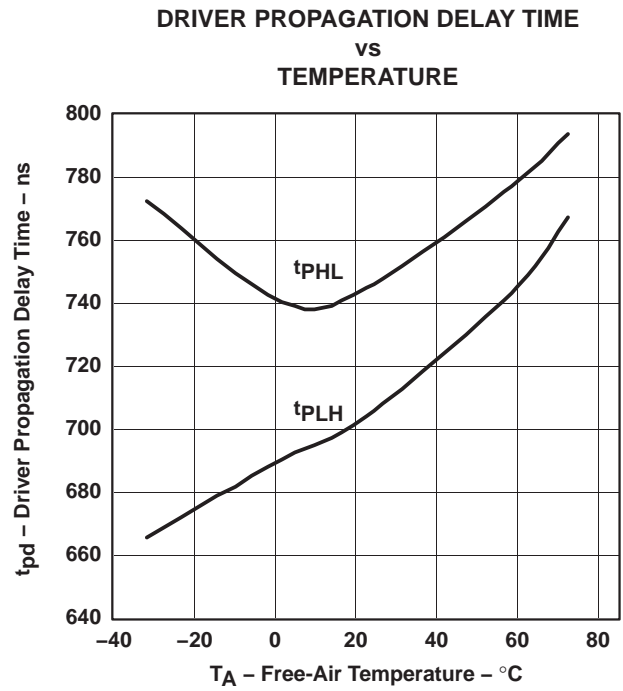


Figure 10

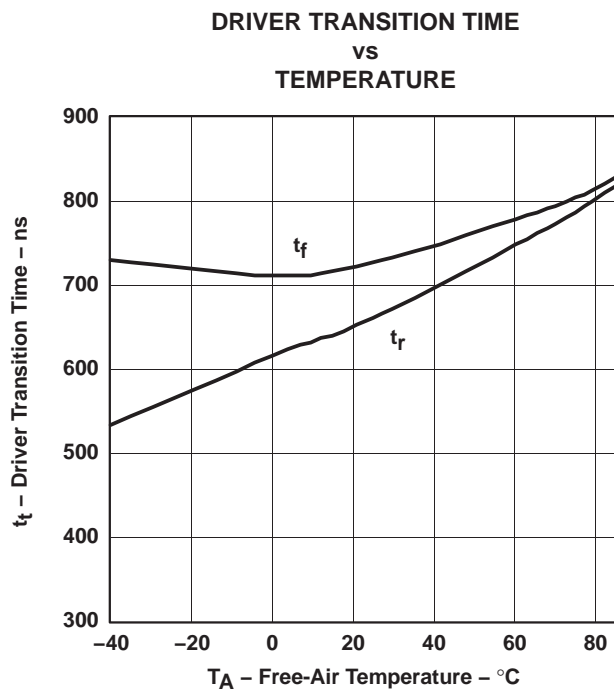


Figure 11

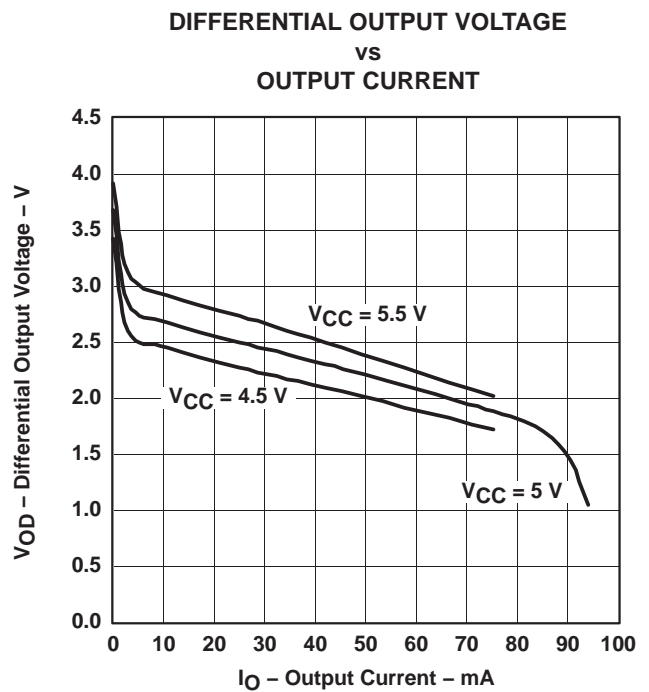
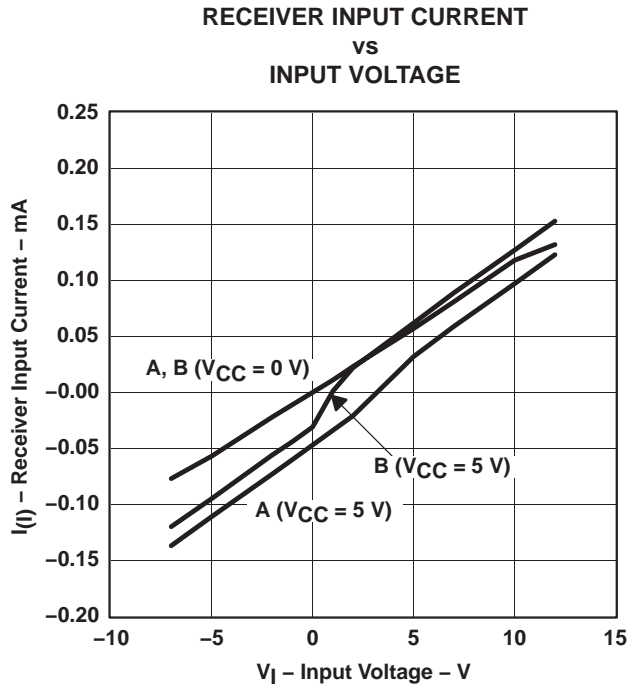


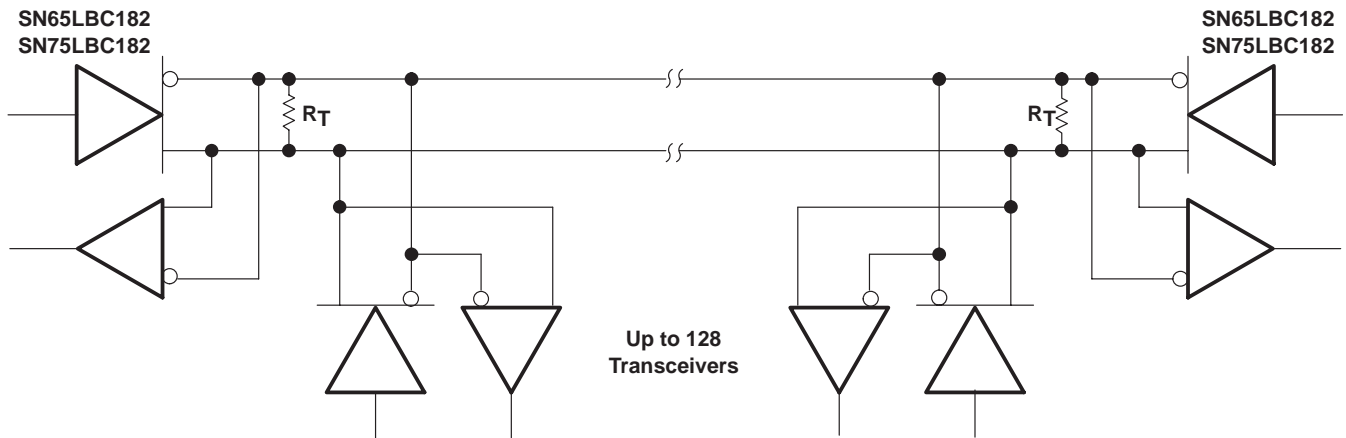
Figure 12

**TYPICAL CHARACTERISTICS**



**Figure 13**

**APPLICATION INFORMATION**



NOTE A: The line should be terminated at both ends in its characteristic impedance ( $R_T = Z_0$ ). Stub lengths off the main line should be kept as short as possible.

**Figure 14. Typical Application Circuit**

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN65LBC182D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC182DG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC182DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC182DRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC182P	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN65LBC182PE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75LBC182D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC182DG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC182DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC182DRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC182P	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75LBC182PE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type

<sup>(1)</sup> 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.

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

<sup>(2)</sup> 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)

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

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P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Falls within JEDEC MS-001

For the latest package information, go to [http://www.ti.com/sc/docs/package/pkg\\_info.htm](http://www.ti.com/sc/docs/package/pkg_info.htm)

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- 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 MS-012 variation AA.

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DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
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		Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
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Mailing Address: Texas Instruments  
Post Office Box 655303 Dallas, Texas 75265

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