

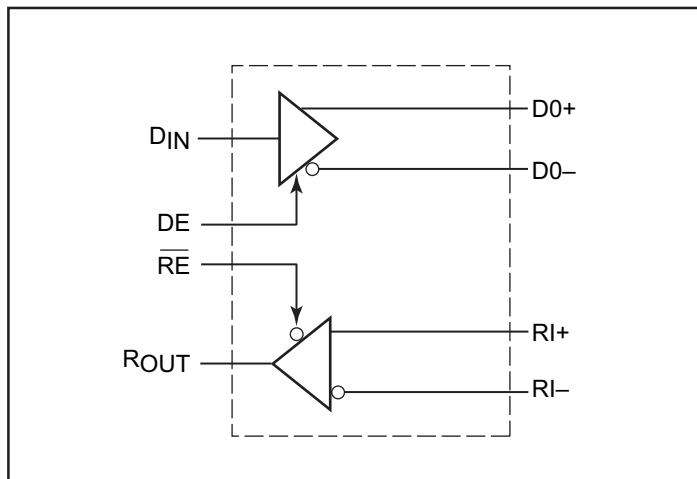
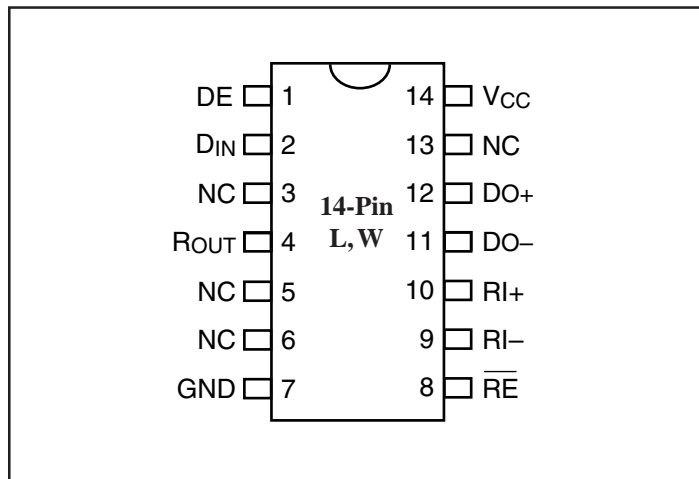
**Single Bus LVDS Transceiver**
**Features**

- Balanced Output Impedance
- Light Bus Loading: 5pF typical
- Glitch-free power up/down (Driver Disabled)
- High Signaling Rate Capability: >500 Mbps
- Driver:
  - $\pm 350\text{mV}$  Differential Swing into:
  - 100-ohm load (PI90LV019)
- Receiver:
  - Accepts  $\pm 50\text{mV}$  (min.) Differential Swing with up to 2.0V ground potential difference
  - Propagation Delay of 3.3ns typ.
  - Low Voltage TTL (LVTTTL) Outputs
  - Open, Short, and Terminated Fail Safe
- Bus terminal ESD exceeds 9kV
- Industrial Temperature Operation ( $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ )
- Packaging: (Pb-free & Green available)  
14-lead SOIC (W) and 14-lead TSSOP (L)

**Description**

The PI90LV019, differential line driver and receiver (transceiver), is compliant to IEEE1596.3 SCI and ANSI/TIA/EIA-644LVDS standards. The logic interface provides maximum flexibility resulting from four separate lines that are provided:  $D_{IN}$ ,  $DE$ ,  $RE$ , and  $R_{OUT}$ . These devices also feature flow through which allows easy PCB routing for short stubs between the bus pins and the connector.

The driver translates between TTL levels (single-ended) to Low Voltage Differential Signaling levels. This allows for high-speed operation, while consuming minimal power with reduced EMI. In addition the differential signaling provides common mode noise rejection of  $\pm 1\text{V}$ .

**Block Diagram**

**Pin Configuration**


**Absolute Maximum Ratings<sup>(1,2)</sup>**

Supply Voltage (V <sub>CC</sub> ) .....	3.6V
Enable Input Voltage (DE, $\overline{RE}$ ) .....	-0.3V to (V <sub>CC</sub> +0.3V)
Driver Input Voltage (DIN) .....	-0.3V to (V <sub>CC</sub> +0.3V)
Receiver Output Voltage (R <sub>OUT</sub> ) .....	-0.3V to (V <sub>CC</sub> +0.3V)
Bus Pin Voltage (DO/RI±) .....	-0.3V to +3.9V
Driver Short Circuit .....	Continuous
ESD (HBM 1.5kohms, 100pF) .....	>9kV
Maximum Package Power Dissipation at 20°C	
SOIC .....	1025mW
Derate SOIC Package .....	8.2mW/°C

Storage Temperature Range .....	-65°C to +150°C
Lead Temperature Range (Soldering, 4s) .....	+260°C

**Recommended Operating Conditions**

	<b>Min.</b>	<b>Max.</b>	<b>Units</b>
Supply Voltage (V <sub>CC</sub> )	3.0	3.6	V
Receiver Input Voltage	0.0	2.9	V
Operating Free-Air Temperature	-40	+85	°C

**Note:**

Stresses greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

**Table 1. Functional Mode**

Mode Selected	DE	$\overline{RE}$
Driver Mode	H	H
Receiver Mode	L	L
3-State Mode	L	H
Full Duplex Mode	H	L

**Table 2. Transmitter Mode**

Inputs		Outputs	
DE	DI	DO+	DO-
H	L	L	H
H	H	H	L
H	2 > & > 0.8	X	X
L	X	Z	Z

**Table 3. Receiver Mode**

Inputs		Outputs
$\overline{RE}$	(RI+) - (RI-)	
L	L (< -100mV)	L
L	H (> +100mV)	H
L	100mV > & > -100mV	X
H	X	Z

**Table 4. Device Pin Description**

Pin Name	Pin #	Inputs/Outputs	Description
DIN	2	I	TTL Driver Input
DO±RI±	6,7	I/O	LVDS Driver Outputs/ LVDS Receiver Inputs
R <sub>OUT</sub>	3	O	TTL Receiver Output
$\overline{RE}$	5	I	Receiver Enable TTL Input (Active Low)
DE	1	I	Driver Enable TTL Input (Active High)
GND	4	NA	Ground
V <sub>CC</sub>	8	NA	Power Supply

**DC Electrical Characteristics<sup>(2,3)</sup>**
 $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ , unless otherwise noted.  $V_{CC} = 3.3\text{V} \pm 0.3\text{V}^{(2,3)}$ 

Symbol	Parameter	Conditions	Pin	Min.	Typ.	Max.	Units	
<b>Differential Driver Characteristics</b>								
$V_{OD}$	Output Differential Voltage	$R_L = 100\text{-ohms, (LV)}$ Figure 1	DO+ DO-	250	350	450	mV	
$\Delta V_{OD}$	$V_{OD}$ Magnitude Change				6	60		
$V_{OS}$	Offset Voltage			1	1.25	1.7	V	
$\Delta V_{OS}$	Offset Magnitude Change				5	60	mV	
$I_{OZD}$	High Impedance Leakage	$V_{OUT} = V_{CC}$ or GND, $DE = 0\text{V}$		-10	$\pm 1$	+10	$\mu\text{A}$	
$I_{OXD}$	Power-Off Leakage	$V_{OUT} = 3.6\text{V}$ or GND, $V_{CC} = 0\text{V}$		-10	$\pm 1$	+10		
$I_{OSD}$	Output Short Circuit Current	$V_{OUT} = 0\text{V}$ , $DE = V_{CC}$	LV	-10	-6	-4	mA	
<b>Differential Receiver Characteristics</b>								
$V_{OH}$	Voltage Output High	$V_{ID} = +100\text{mV}$	$R_{OUT}$	2.9	3.3		V	
		Inputs Open			2.9	3.3		
$V_{OL}$	Voltage Output Low	$I_{OL} = 2.0\text{mA}$ , $V_{ID} = -100\text{mV}$				0.1		0.4
$I_{OS}$	Output Short Circuit Current	$V_{OUT} = 0\text{V}$		-75	-34	-20	mA	
$V_{TH}$	Input Threshold High		RI+ RI-			+100	mV	
$V_{TL}$	Input Threshold Low				-100			
$I_{IN}$	Input Current	$V_{IN} = +2.4\text{V}$ , or $0\text{V}$ $V_{CC} = 3.6\text{V}$ or $0\text{V}$			-10	$\pm 1$		$\pm 10$
<b>Device Characteristics</b>								
$V_{IH}$	Minimum Input High Voltage		$D_{IN}$ , DE, RE	2.0		$V_{CC}$	V	
$V_{IL}$	Minimum Input Low Voltage				GND	0.8		
$I_{IH}$	Input High Current	$V_{IN} = V_{CC}$ or $2.4\text{V}$				$\pm 1$	+10	$\mu\text{A}$
$I_{IL}$	Input Low Current	$V_{IN} = \text{GND}$ or $0.4\text{V}$			$\pm 1$	+10		
$V_{CL}$	Input Diode Clamp Voltage	$I_{CLAMP} = -18\text{mA}$		-1.5	-0.7		V	
$I_{CC}$	No Load Driver Enabled	$D_{IN} = V_{CC}$ or GND $DE = V_{CC} = \text{RE}$	LV		4.0	8.0	mA	
$I_{CCL}$	Loaded driver enabled	$R_L = 100\text{ ohms}$ (all channels) $D_{IN} = V_{CC}$ or GND (all inputs) $DE = V_{CC}$ , $RE = \text{GND}$	LV		20	30		
$I_{CCZ}$	No Load driver disabled	$D_{IN} = V_{CC}$ or GND, $DE = \text{GND}$ , $RE = V_{CC}$	LV		2.2	8.0		
$C_{Doutput}$	Capacitance	—	DO+, DO-		5		pF	
$C_{Rinput}$	Capacitance		RI+, RI-		5			

**Notes:**

1. “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of “Electrical Characteristics” specifies conditions of device operation.
2. All currents into device pins are positive, all currents out of device pins are negative. All voltages are referenced to ground except:  $V_{OD}$ ,  $V_{ID}$ ,  $V_{TH}$ , and  $V_{TL}$ , unless otherwise specified.
3. All typicals are given for  $V_{CC} = +3.3\text{V}$  and  $T_A = +25^\circ\text{C}$  unless otherwise stated.

Notes continued on next page...

**Notes (continued):**

4. ESD Rating: HBM (15k-ohms, 100pF) > 2.0kV EAT (0-ohm, 200pF) > 300V.
5.  $C_L$  includes probe and fixture capacitance.
6. Generator waveforms for all tests unless otherwise specified:  $f = 1\text{MHz}$ ,  $Z_0 = 50\text{-ohms}$ ,  $t_r, t_f \leq 6.0\text{ns}$  (0% - 100%) on control pins and  $\leq 1.0\text{ns}$  for RI inputs.
7. For receiver disable delays, the switch is set to  $V_{CC}$  for  $t_{pZL}$ , and  $t_{PLZ}$  and to GND for  $t_{pZH}$  and  $t_{PHZ}$ .

**AC Electrical Characteristics**

$T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 0.3\text{V}^{(6)}$

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
<b>Driver Timing Requirements</b>						
$t_{PHLD}$	Differential Propagation Delay High to Low	$R_L = 100\text{-ohms (LV)}$ $C_L = 10\text{pF}$ (Figures 2 & 3)	2.0	4.0	6.5	ns
$t_{PLHD}$	Differential Propagation Delay Low to High		1.0	5.6	7.0	
$t_{SKD}$	Differential Skew $ t_{PHLD} - t_{PLHD} $			0.4	1.0	
$t_{TLH}$	Transition Time Low to High		0.2	0.7	3.0	
$t_{THL}$	Transition Time High to Low		0.2	0.8	3.0	
$t_{PHZ}$	Disable Time High to Z	$R_L = 100\text{-ohms (LV)}$ $C_L = 10\text{pF}$ (Figures 2 & 3)	1.5	4.0	8.0	ns
$t_{PLZ}$	Disable Time Low to Z		2.5	5.3	9.0	
$t_{pZH}$	Enable Time Z to High		4.0	6.0	8.0	
$t_{pZL}$	Enable Time Z to Low		3.5	6.0	8.0	
<b>Receiver Timing Requirements</b>						
$t_{PHLD}$	Differential Propagation Delay High to Low	$C_L = 10\text{pF}$ $V_{ID} = 200\text{mV}$ Figures 6 & 7	1.3	2.1	3.0	ns
$t_{PLHD}$	Differential Propagation Delay Low to High		1.3	2.1	3.0	
$t_{SKD}$	Differential Skew $ t_{PHLD} - t_{PLHD} $			0.5	2.0	
$t_r$	Rise Time			0.8	1.4	
$t_f$	Fall Time			0.8	1.4	
$t_{PHZ}$	Disable Time High to Z	$R_L = 500\text{-ohms}$ $C_L = 10\text{pF}$ Figures 8 & 9	3.0	4.0	6.0	ns
$t_{PLZ}$	Disable Time Low to Z		3.0	4.5	6.0	
$t_{pZH}$	Enable Time Z to High		3.0	6.0	8.0	
$t_{pZL}$	Enable Time Z to Low		3.0	6.0	8.0	

Test Circuits and Timing Waveforms

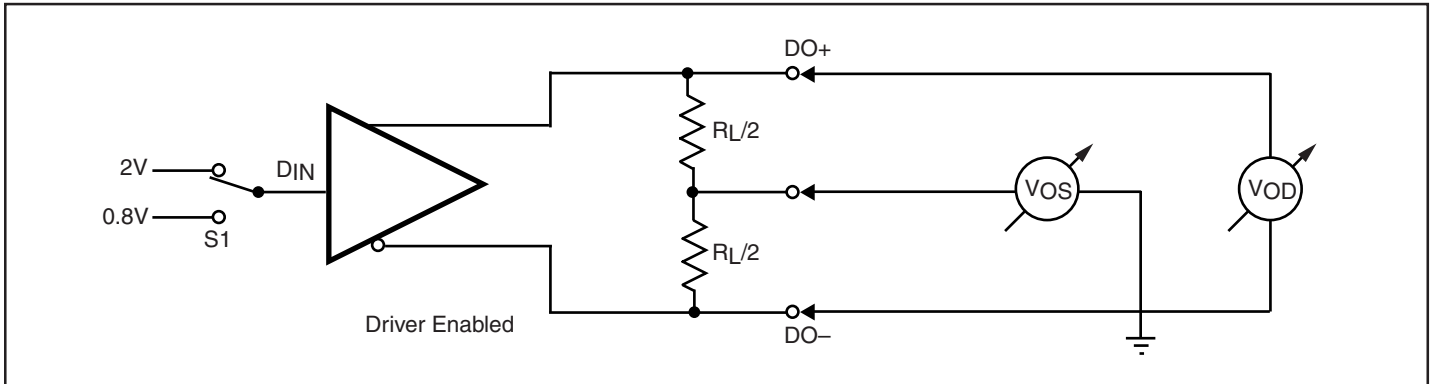


Figure 1. Differential Driver DC Test Circuit

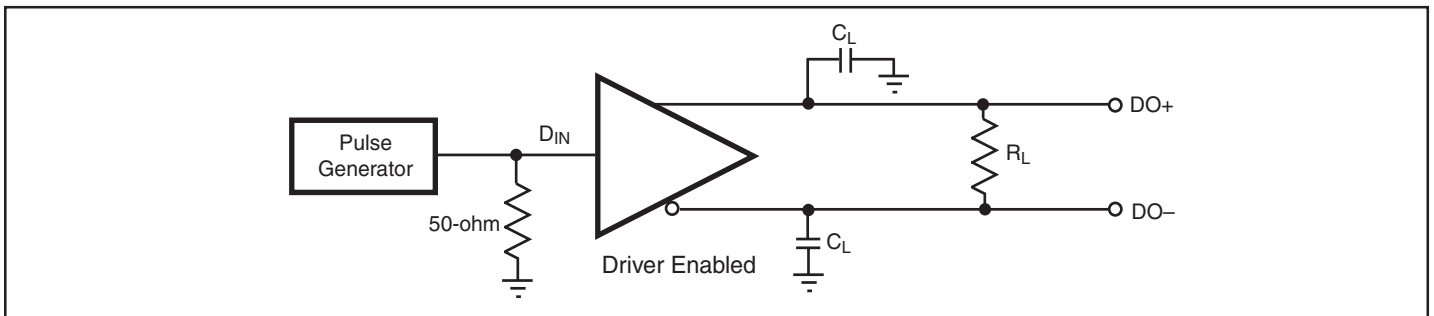


Figure 2. Differential Driver Propagation Delay and Transition Time Test Circuit

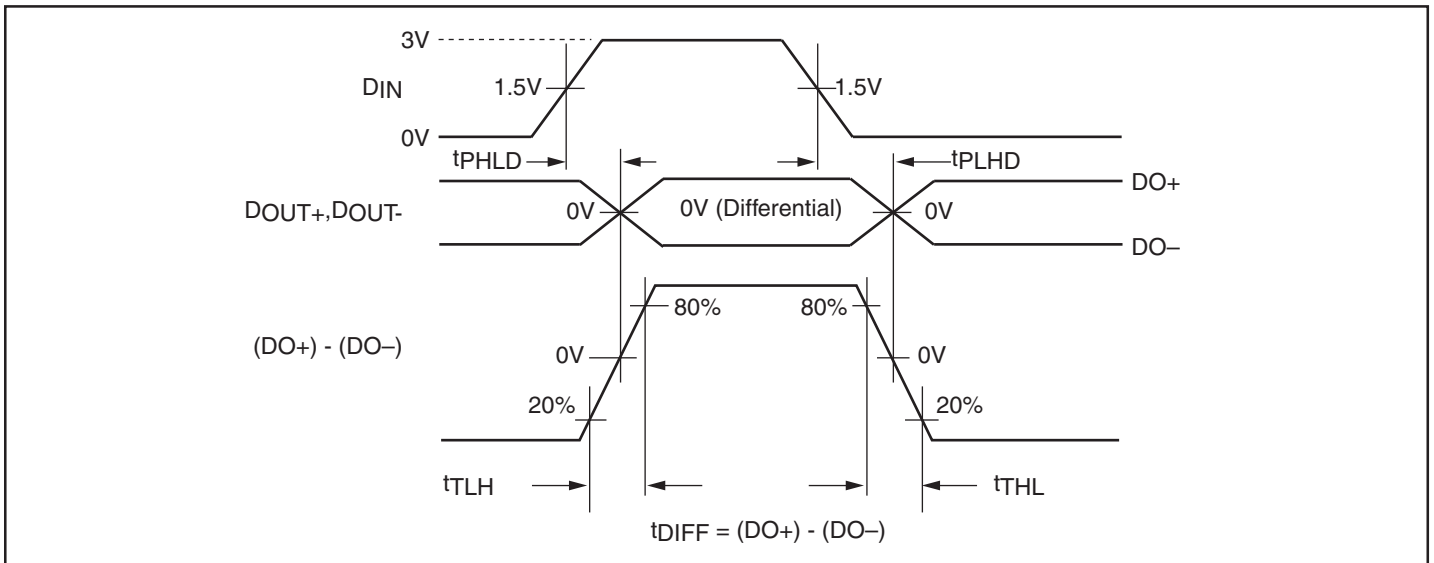


Figure 3. Driver Propagation Delay and Transition Time Waveforms

Test Circuits and Timing Waveforms (continued)

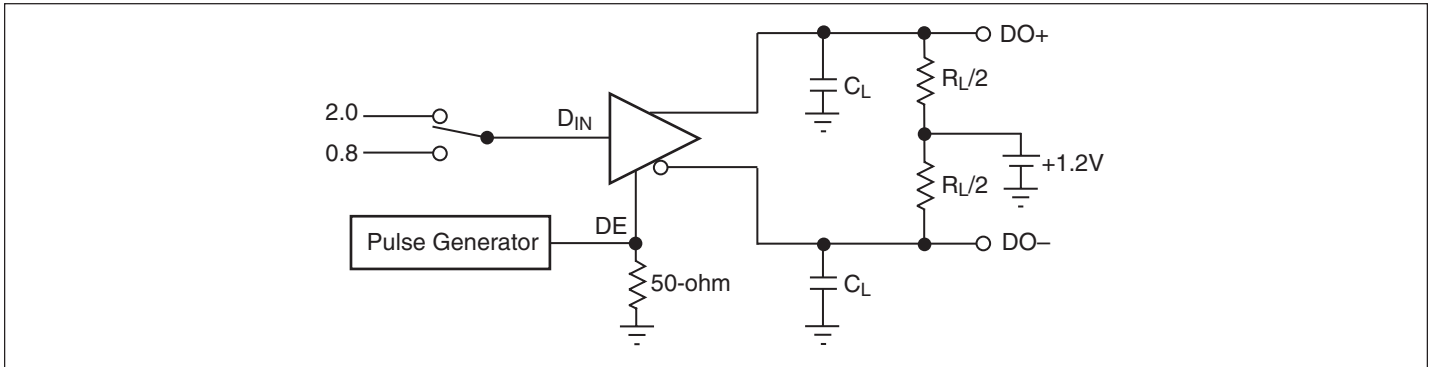


Figure 4. Driver Three-State Delay Test Circuit

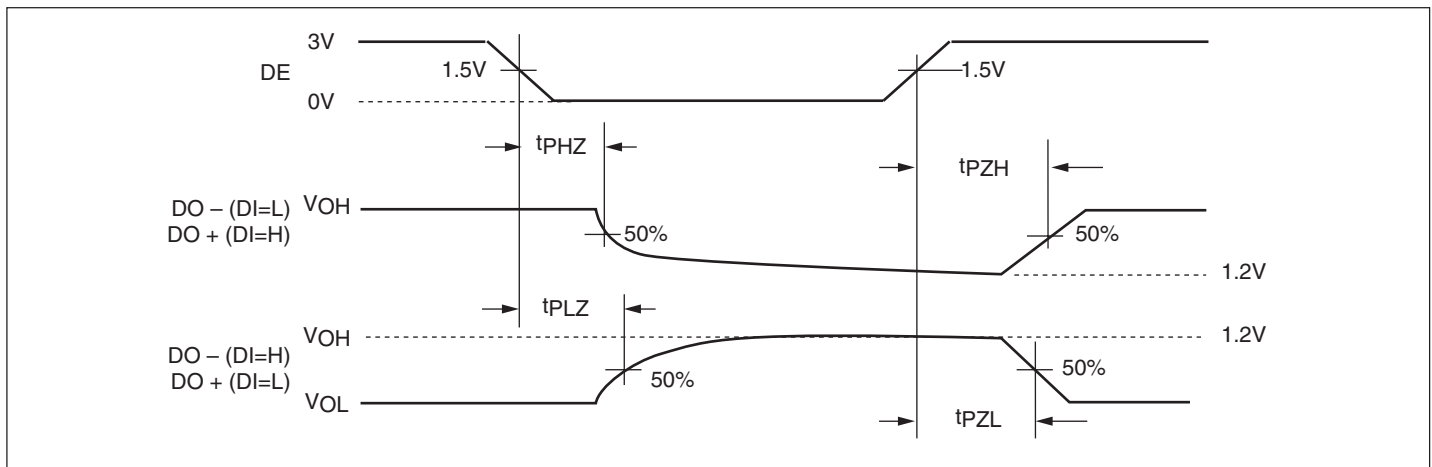


Figure 5. Driver Three-State Delay Waveforms

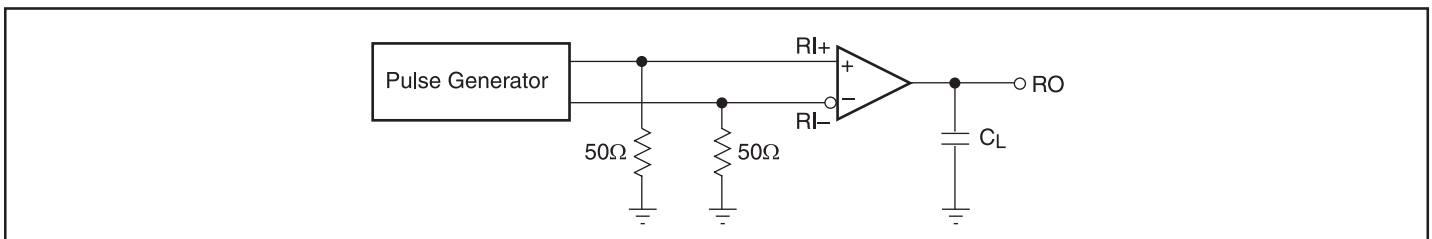


Figure 6. Receiver Propagation Delay and Transition Time Test Circuit

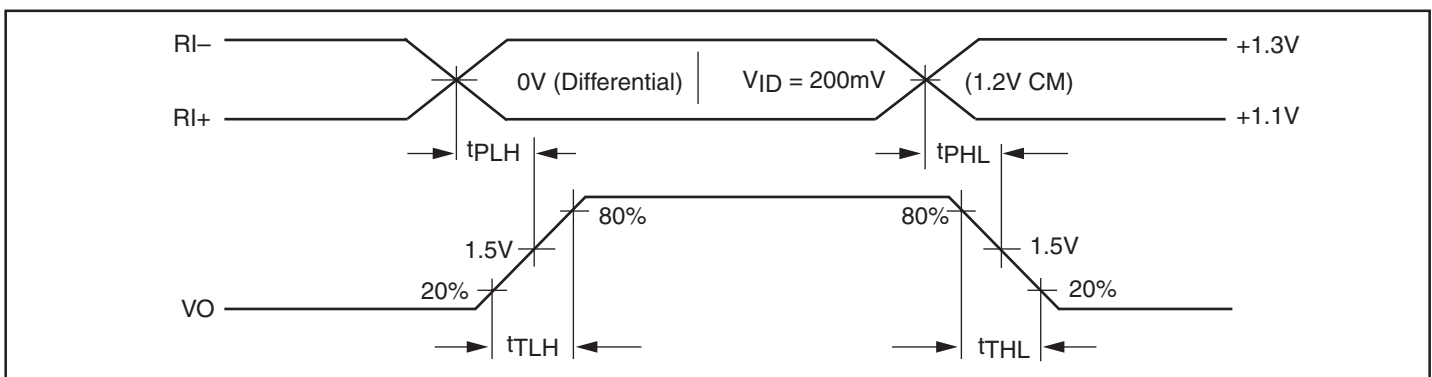


Figure 7. Receiver Propagation Delay and Transition Time Waveforms

Test Circuits and Timing Waveforms (continued)

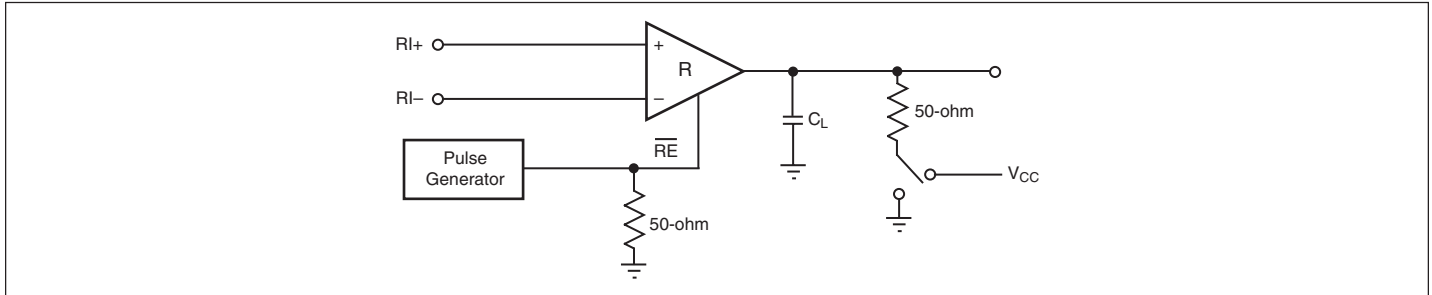


Figure 8. Receiver 3-State Delay Test Circuit

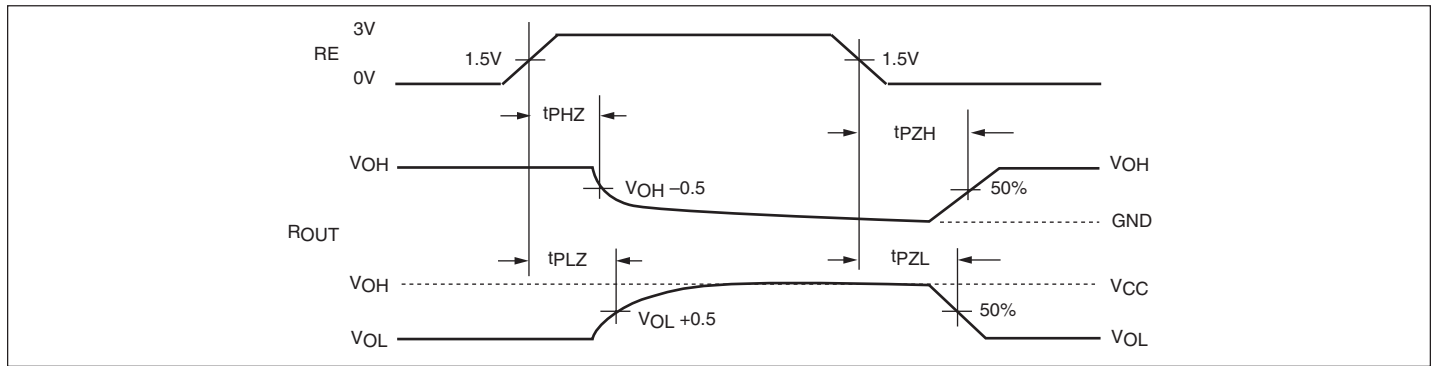


Figure 9. Receiver 3-State Delay Waveforms

Typical Bus Application Configurations

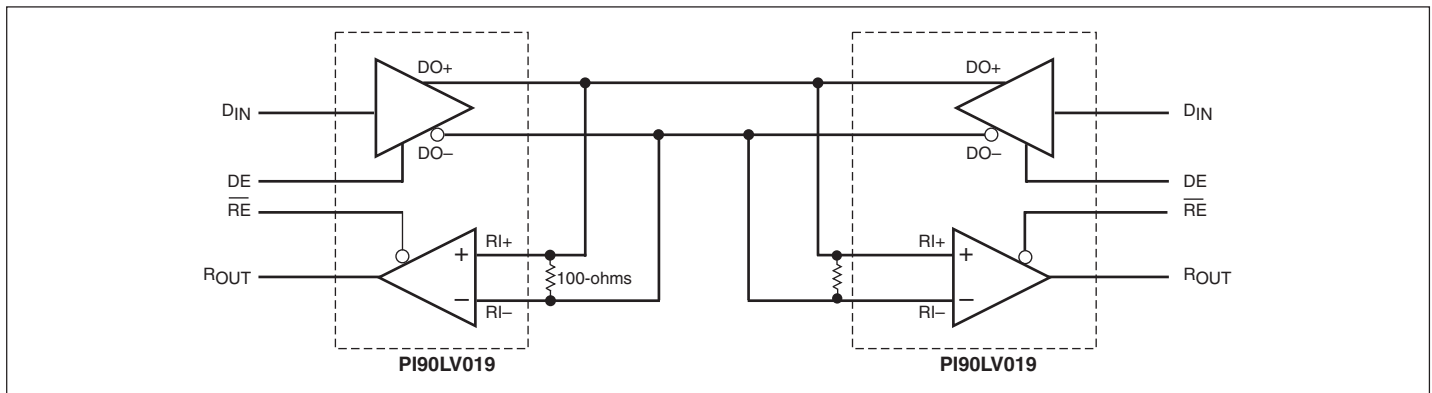


Figure 10. Bidirectional Half-Duplex Point-to-Point Applications

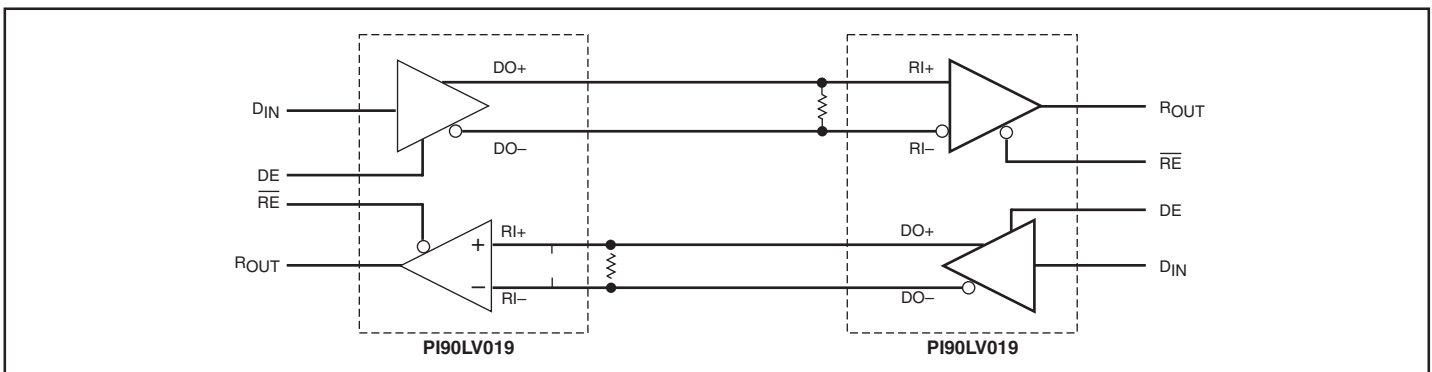
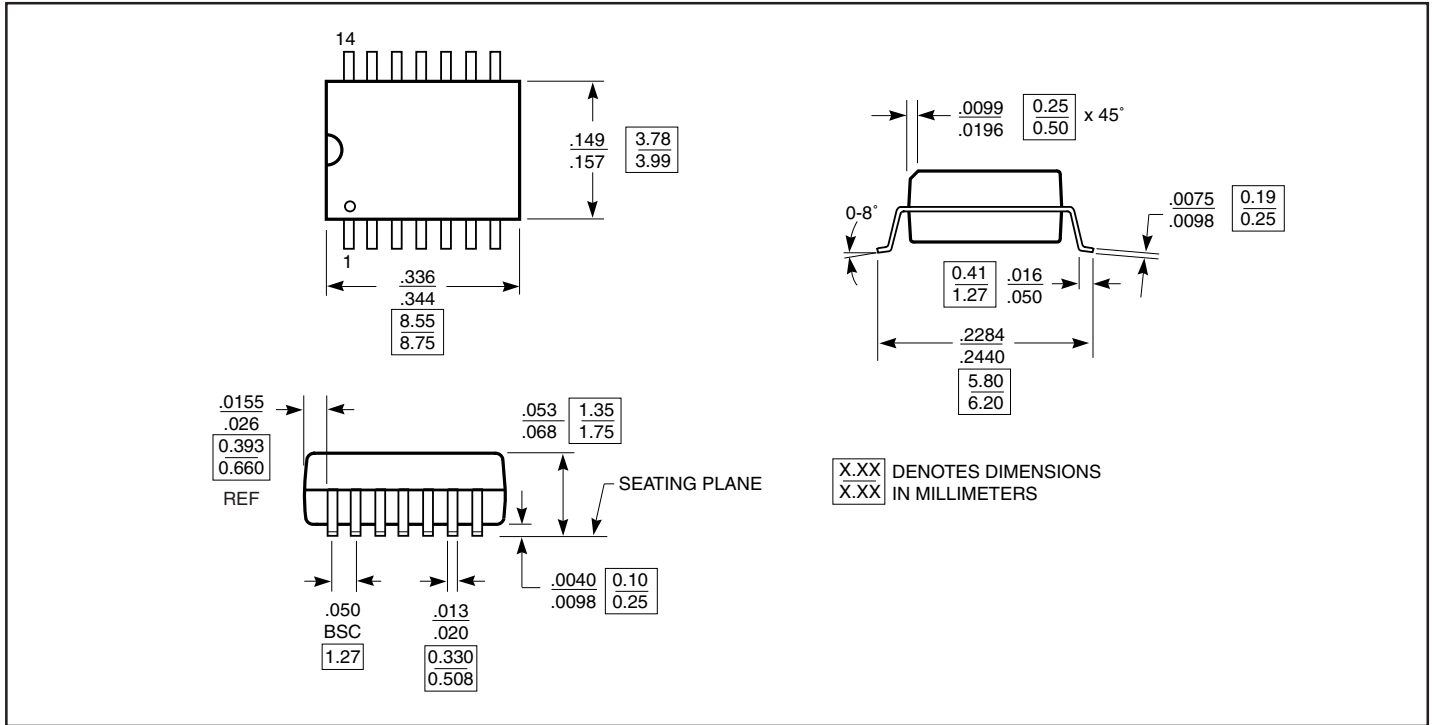
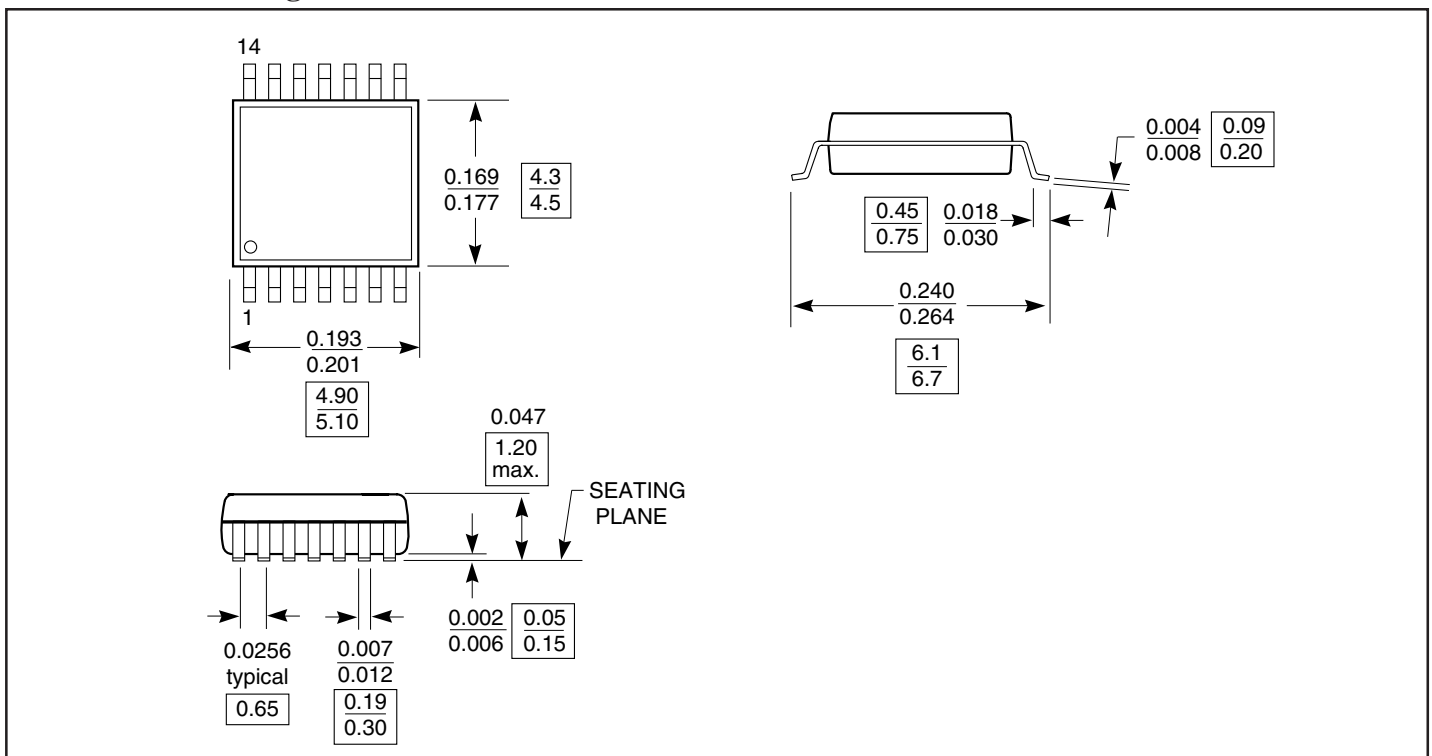


Figure 11. Full-Duplex Point-to-Point Application

### 14-Pin SOIC Package



### 14-Pin TSSOP Package





**Ordering Information**

<b>Order Number</b>	<b>Pins - Package</b>	<b>Temperature</b>
PI90LV019W	14 - SOIC	-40°C to 85°C
PI90LV019WE	14 - SOIC, Pb-free & Green	-40°C to 85°C
PI90LV019L	14 - TSSOP	-40°C to 85°C
PI90LV019LE	14 - TSSOP, Pb-free & Green	-40°C to 85°C