

**3.3V LVDS High-Speed Differential  
Line Drivers and Receivers**

**Features**

- Signaling Rates >660 Mbps (330 MHz)
- Single 3.3V Power Supply Design
- Driver:
  - $\pm 350\text{mV}$  Differential Swing into a 100-ohm load
  - Propagation Delay of 1.5ns Typ.
  - Low Voltage TTL (LVTTTL) Inputs are 5V Tolerant
- 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
- Industrial Temperature Operating Range:  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$
- Meets or Exceeds IEEE 1596.3 SCI Standard
- Meets or Exceeds ANSI/TIA/EIA-644 LVDS Standard
- Bus-Terminal ESD exceeds 12kV
- Packaging (Pb-free & Green available):
  - 8-pin, 14-pin, or 16-pin SOIC, TSSOP, or MSOP

**Description**

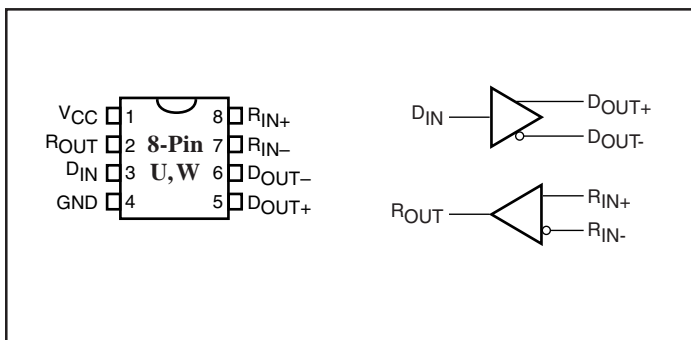
The PI90LV179, PI90LV180, PI90LV050, and PI90LV051 are differential line drivers and receivers (transceivers) that are compliant with the IEEE 1596.3 SCI and ANSI/TIA/EIA-644 LVDS standards. These devices use low-voltage differential signaling (LVDS) to achieve data rates in excess of 660 Mbps while being less susceptible to noise than single-ended transmission.

The drivers translate a low-voltage TTL/CMOS input into a low-voltage (350mV typical) differential output signal. The receivers translate a differential 350mV input signal to a 3V CMOS output level. The driver section can be independently set to a power-down and high-impedance output mode with the DEN pin (active HIGH). The receiver section is controlled by the REN\* pin (active LOW).

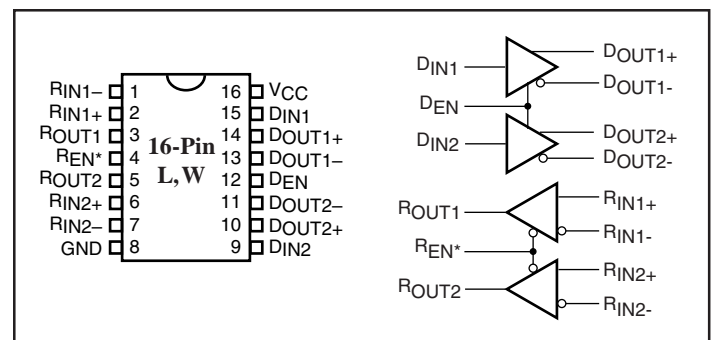
**Applications**

Applications include point-to-point and multidrop baseband data transmission over a controlled impedance media of approximately 100 ohms. These include intra-system connections via printed circuit board traces or cables, hubs and routers for data communications; PBXs, switches, repeaters and base stations for telecommunications and other applications such as digital cameras, printers and copiers.

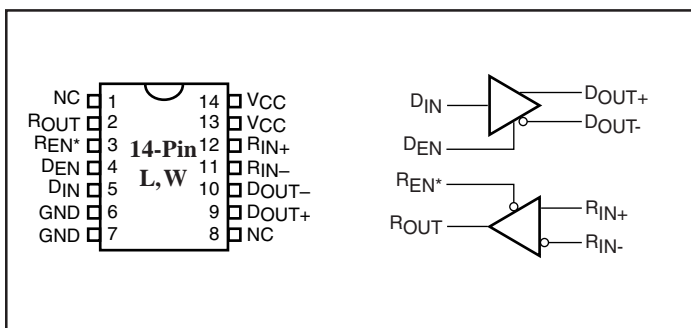
**PI90LV179**



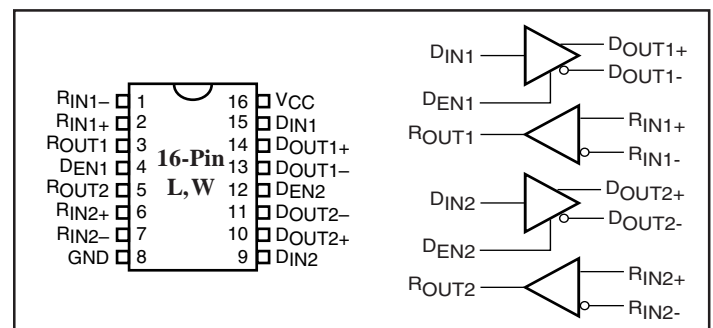
**PI90LV050**



**PI90LV180**



**PI90LV051**



## Function Tables

### PI90LV179 Receiver

Inputs	Output
$V_{ID} = V_{RIN+} - V_{RIN-}$	$R_{OUT}$
$V_{ID} \geq 50mV$	H
$-50mV < V_{ID} < 50mV$	?
$V_{ID} \leq -50mV$	L
open	H

### PI90LV179 Driver

Input	Output	
$D_{IN}$	$D_{OUT+}$	$D_{OUT-}$
L	L	H
H	H	L
open	L	H

### PI90LV180/PI90LV050/PI90LV051 Receivers

Inputs	Output	
$V_{ID} = V_{RIN+} - V_{RIN-}$	$R_{EN}^*$	$R_{OUT}$
$V_{ID} \geq 50mV$	L	H
$-50mV < V_{ID} < 50mV$	L	?
$V_{ID} \leq -50mV$	L	L
open	L	H
X	H	Z

### PI90LV180/PI90LV050/PI90LV051 Drivers

Inputs		Output	
$D_{IN}$	$D_{EN}$	$D_{OUT+}$	$D_{OUT-}$
L	H	L	H
H	H	H	L
open	H	L	H
X	L	Z	Z

#### Notes:

H = High Level, L = Low Level, ? = Indeterminate,  
Z = High-Impedance, X = Don't Care

## Pin Descriptions

Name	Description
$D_{IN}$	TTL/CMOS driver input pins
$D_{OUT+}$	Non-inverting driver output pins
$D_{OUT-}$	Inverting driver output pins
$R_{OUT}$	TTL/CMOS receiver output pins
$R_{IN+}$	Non-inverting receiver input pins
$R_{IN-}$	Inverting receiver input pins
$V_{ID}$	Input Differential Signal Voltage
GND	Ground pin
$V_{CC}$	Positive power supply pin, +3.3V $\pm$ 10%

## Absolute Maximum Ratings

Supply Voltage ( $V_{CC}$ )	-0.5V to +4.0V
Driver	
Input Voltage ( $D_{IN}$ )	-0.3V to ( $V_{CC} + 0.3V$ )
Output Voltage ( $D_{OUT+}, D_{OUT-}$ )	-0.3V to +3.9V
Short Circuit Duration ( $D_{OUT+}, D_{OUT-}$ )	Continuous
Enable Input Voltage ( $D_{EN}$ )	-0.3V to ( $V_{CC} + 0.3V$ )
Receiver	
Input Voltage ( $R_{IN+}, R_{IN-}$ )	-0.3V to +3.9V
Output Voltage ( $R_{OUT}$ )	-0.3V to ( $V_{CC} + 0.3V$ )
Enable Input Voltage ( $R_{EN}^*$ )	-0.3V to ( $V_{CC} + 0.3V$ )
Storage Temperature Range	-65°C to +150°C
Lead Temperature Range Soldering (4s)	+260°C
Maximum Junction Temperature	+150°C
ESD Rating	>12kV

## Recommended Operating Conditions

	Min.	Typ.	Max.	Units
Supply Voltage ( $V_{CC}$ )	3	3.3	3.6	V
High Level Input Voltage, $V_{IH}$	2			
Low Level Input Voltage, $V_{IL}$			0.8	
Magnitude of Differential Input Voltage $V_{ID}$	0.1		0.6	
Common-mode Input Voltage, $V_{IC}$ (Fig 5)	$ V_{ID} /2$		2.4 $- V_{ID} /2$ $V_{CC} - 0.8$	
Operating Free Air Temperature $T_A$	-40		85	°C

**Electrical Characteristics** (Over recommended operating conditions unless otherwise noted).

Parameter		Test Condition	Min.	Typ. <sup>†</sup>	Max.	Units
I <sub>CC</sub> * Supply Current	PI90LV179	No receiver load, Driver R <sub>L</sub> = 100 ohms		8.0	10.8	mA
	PI90LV180	Driver and receiver enabled. No receiver load, Driver R <sub>L</sub> = 100 ohms		8.0	10.8	
		Driver enabled, Receiver disabled, R <sub>L</sub> = 100 ohms		6.4	9	
		Driver disabled, Receiver enabled, No load		3.4	5	
		Disabled		0.76	1.2	
	PI90LV050	Driver and receivers enabled. No receiver loads, Driver R <sub>L</sub> = 100 ohms		15	20.0	
		Drivers enabled, Receivers disabled, R <sub>L</sub> = 100 ohms		10	14	
		Drivers disabled, Receivers enabled, No loads		6	8	
		Disabled		0.9	1.2	
	PI90LV051	Drivers enabled, No receiver loads, Driver R <sub>L</sub> = 100 ohms		17.8	23.3	
Drivers disabled, No loads			6.5	9.1		

<sup>†</sup>All typical values are at 25°C with a 3.3V supply

\*<sub>CC</sub> measured with all TTL input. V<sub>IN</sub> = V<sub>CC</sub> or GND.

**Electrical Characteristics** (Over recommended operating conditions unless otherwise noted).

Parameter		Test Conditions	Min.	Typ.	Max.	Units
V <sub>OD</sub>	Differential output voltage magnitude	R <sub>L</sub> = 100 ohms See Figures 1 and 2	247	390	470	mV
Δ V <sub>OD</sub>	Change in differential output voltage magnitude between logic states		-50		50	
V <sub>OC(SS)</sub>	Steady-state common-mode output voltage	See Figure 3	1.125	1.25	1.375	V
ΔV <sub>OC(SS)</sub>	Change in steady-state common-mode output voltage between logic states		-50		50	mV
V <sub>OC(PP)</sub>	Peak-to-peak common-mode output voltage			50	150	
I <sub>IH</sub>	High-level input current	DE	V <sub>IH</sub> = 5V	-0.5	-20	μA
		D <sub>IN</sub>		2	20	
I <sub>IL</sub>	Low-level input current	DE	V <sub>IL</sub> = 0.8V	-0.5	-10	
		D <sub>IN</sub>		2	10	
I <sub>OS</sub>	Short-circuit output current	V <sub>OY</sub> or V <sub>OZ</sub> = 0V		-6	-9	mA
		V <sub>OD</sub> = 0V		-8	-11	
I <sub>OZ</sub>	High-impedance output current	V <sub>OD</sub> = 600mV			±1	μA
		V <sub>O</sub> = 0V or V <sub>CC</sub>			±1	
I <sub>O(OFF)</sub>	Power-off output current	V <sub>CC</sub> = 0V, V <sub>O</sub> = 3.6V			±1	
C <sub>IN</sub>	Input capacitance			7		pF

**Receiver Electrical Characteristics** (Over recommended operating conditions unless otherwise noted).

Parameter		Test Conditions	Min.	Typ.	Max.	Units
V <sub>ITH+</sub>	Positive-going differential input voltage threshold	See Figures 5 & Table 1			50	mV
V <sub>ITH-</sub>	Negative-going differential input voltage threshold		-50			
V <sub>OH</sub>	High-level output voltage	I <sub>OH</sub> = -8mA	2.4			V
V <sub>OL</sub>	Low-level output voltage	I <sub>OL</sub> = 8mA			0.4	V
I <sub>I</sub>	Input current (R <sub>IN+</sub> or R <sub>IN-</sub> )	V <sub>I</sub> = 0	-2	-11	-20	μA
		V <sub>I</sub> = 2.4V	-1.2	-3		
I <sub>I (OFF)</sub>	Power-off input current (R <sub>IN+</sub> or R <sub>IN-</sub> )	V <sub>CC</sub> = 0			±20	
I <sub>H</sub>	High-level input current (enables)	V <sub>IH</sub> = 2V			±10	
I <sub>L</sub>	Low-level input current (enables)	V <sub>IL</sub> = 0.8V			±10	
I <sub>OZ</sub>	High-impedance output current	V <sub>O</sub> = 0 or 5V			±10	
C <sub>I</sub>	Input capacitance			5		

† All typical values are at 25°C with a 3.3V supply

**Driver Switching Characteristics** (Over recommended operating conditions unless otherwise noted).

Parameter		Test Conditions	Min.	Typ. <sup>†</sup>	Max.	Units
t <sub>PLH</sub>	Propagation delay time, low-to-high-level output	R <sub>L</sub> = 100 ohms C <sub>L</sub> = 10pF See Figure 2		1.9	2.5	ns
t <sub>PHL</sub>	Propagation delay time, high-to-low-level output			1.9	2.5	
t <sub>r</sub>	Differential output signal rise time			0.6	1.1	
t <sub>f</sub>	Differential output signal fall time			0.6	1.1	
t <sub>sk(p)</sub>	Pulse skew (t <sub>PHL</sub> - t <sub>PLH</sub> )				270	ps
t <sub>sk(o)</sub>	Channel-to-channel output skew <sup>‡</sup>			80		
t <sub>sk(pp)</sub>	Part-part-part skew <sup>**</sup>			0.9	ns	
t <sub>PZH</sub>	Propagation delay time, high-impedance-to-high-level output	See Figure 7		2.7		4
t <sub>PZL</sub>	Propagation delay time, high-impedance-to-low-level output			1.8		4
t <sub>PHZ</sub>	Propagation delay time, high-level-to-high-impedance output			3.0		4
t <sub>PLZ</sub>	Propagation delay time, low-level-to-high-impedance output			3.0		4

† All typical values are at 25°C with a 3.3V supply.

‡ t<sub>sk(o)</sub>: maximum delay time difference between drivers on the same device.

\*\* t<sub>sk(pp)</sub>: magnitude of difference in propagation delay times between any specific terminals of two devices (all things being equal).

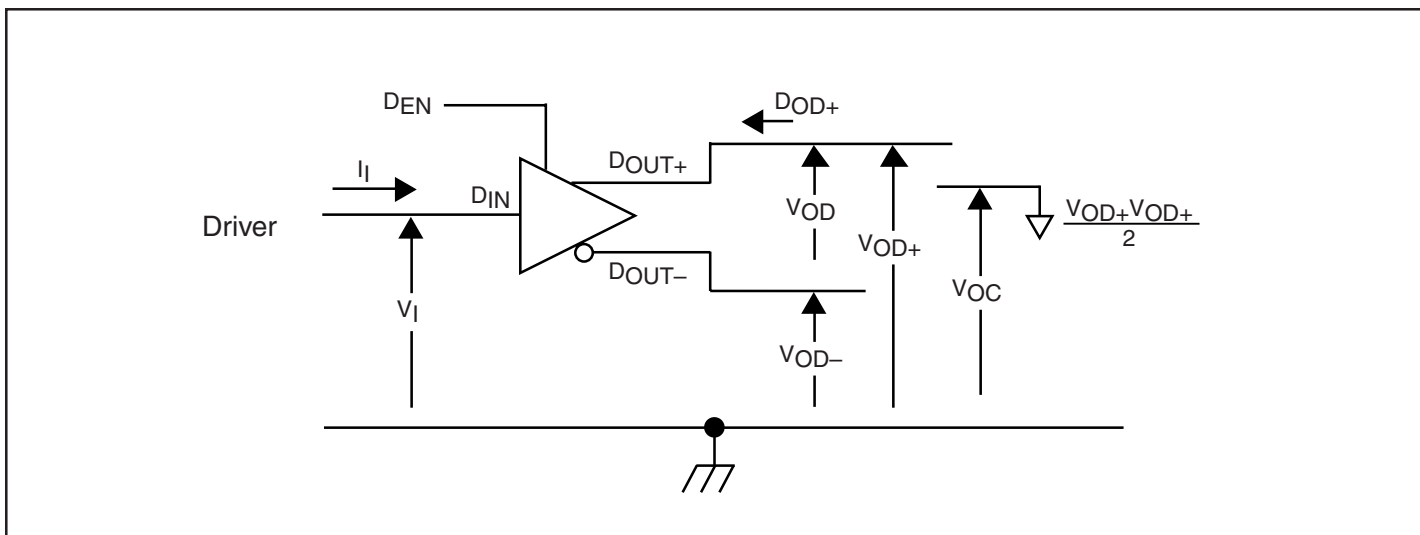
**Receiver Switching Characteristics** (Over recommended operating conditions unless otherwise noted).

Parameter		Test Conditions	Min.	Typ. <sup>†</sup>	Max.	Units	
t <sub>PLH</sub>	Propagation delay time, low-to-high-level output	C <sub>L</sub> = 10pF See Figure 6		2.0	3.1	ns	
t <sub>PHL</sub>	Propagation delay time, high-to-low-level output			2.2	3.1		
t <sub>sk(pp)**</sub>	Part-part-part skew**				1.3		
t <sub>sk(p)</sub>	Pulse skew (t <sub>PHL</sub> – t <sub>PLH</sub> )				300	500	ps
t <sub>sk(o)</sub>	Channel-to-channel skew				30	120	
t <sub>r</sub>	Output signal rise time				0.9	1.5	
t <sub>f</sub>	Output signal fall time				1.0	1.8	
t <sub>PZH</sub>	Propagation delay time, high-level-to-high-impedance output	See Figure 7		1.5	3.1	ns	
t <sub>PZL</sub>	Propagation delay time, low-level-to-low-impedance output				4.0	6.0	
t <sub>PHZ</sub>	Propagation delay time, high-impedance-to-high-level output				2.5	3.5	
t <sub>PLZ</sub>	Propagation delay time, low-impedance-to-high-level output				6.0	7.6	

†All typical values are at 25°C with a 3.3V supply

\*\*t<sub>sk(pp)</sub>: magnitude of difference in propagation delay times between any specific terminals of two devices (all things being equal)

**Parameter Measurement Information**



**Figure 1. Driver Voltage and Current Definitions**

### Parameter Measurement Information

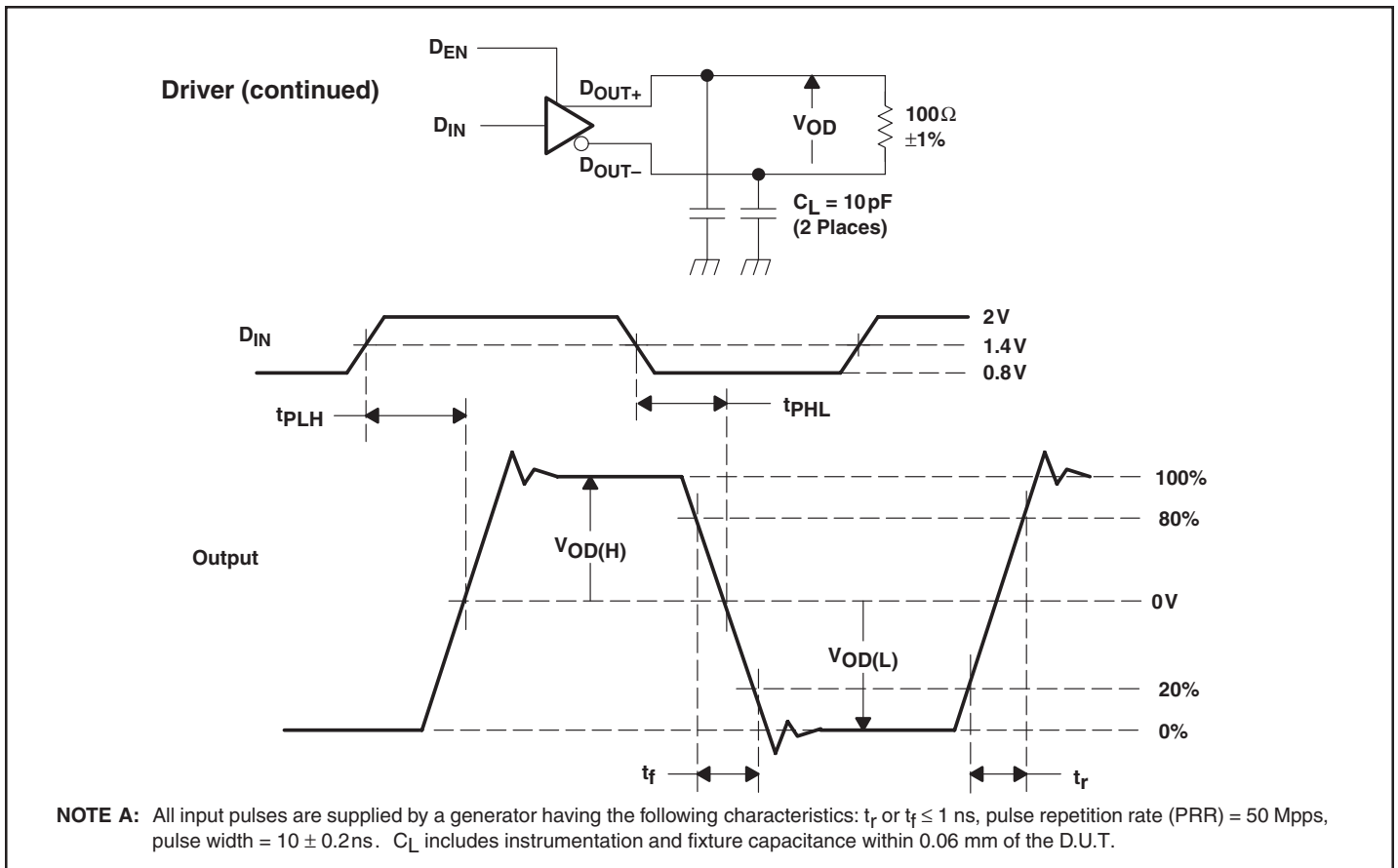


Figure 2. Test Circuit, Timing, and Voltage Definitions for the Differential Output Signal

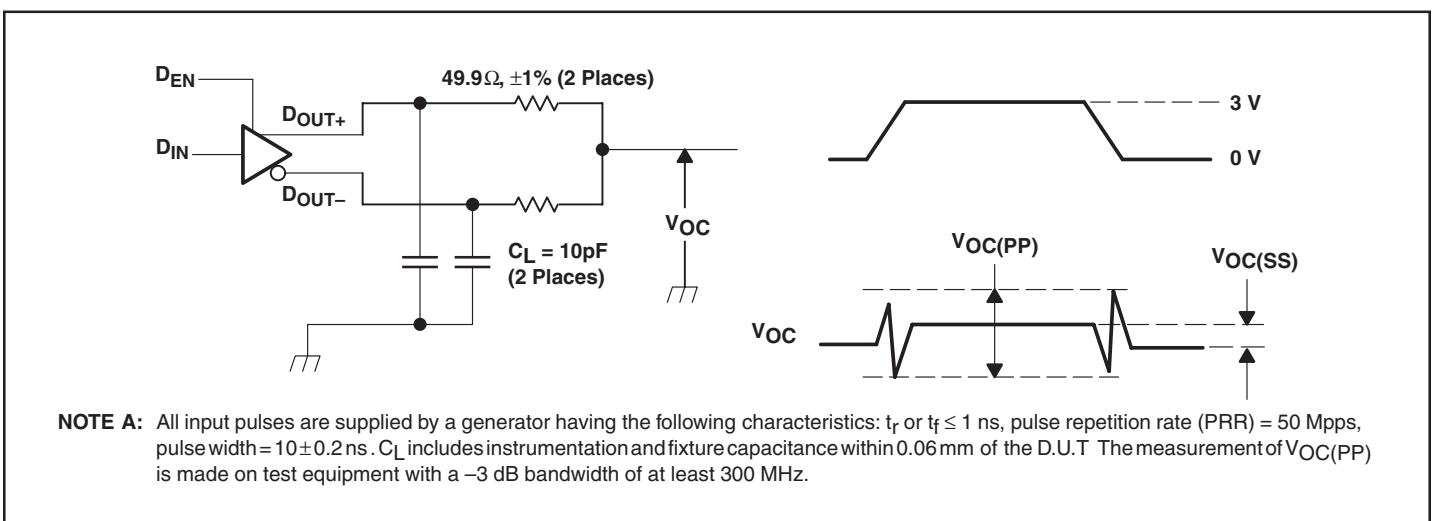
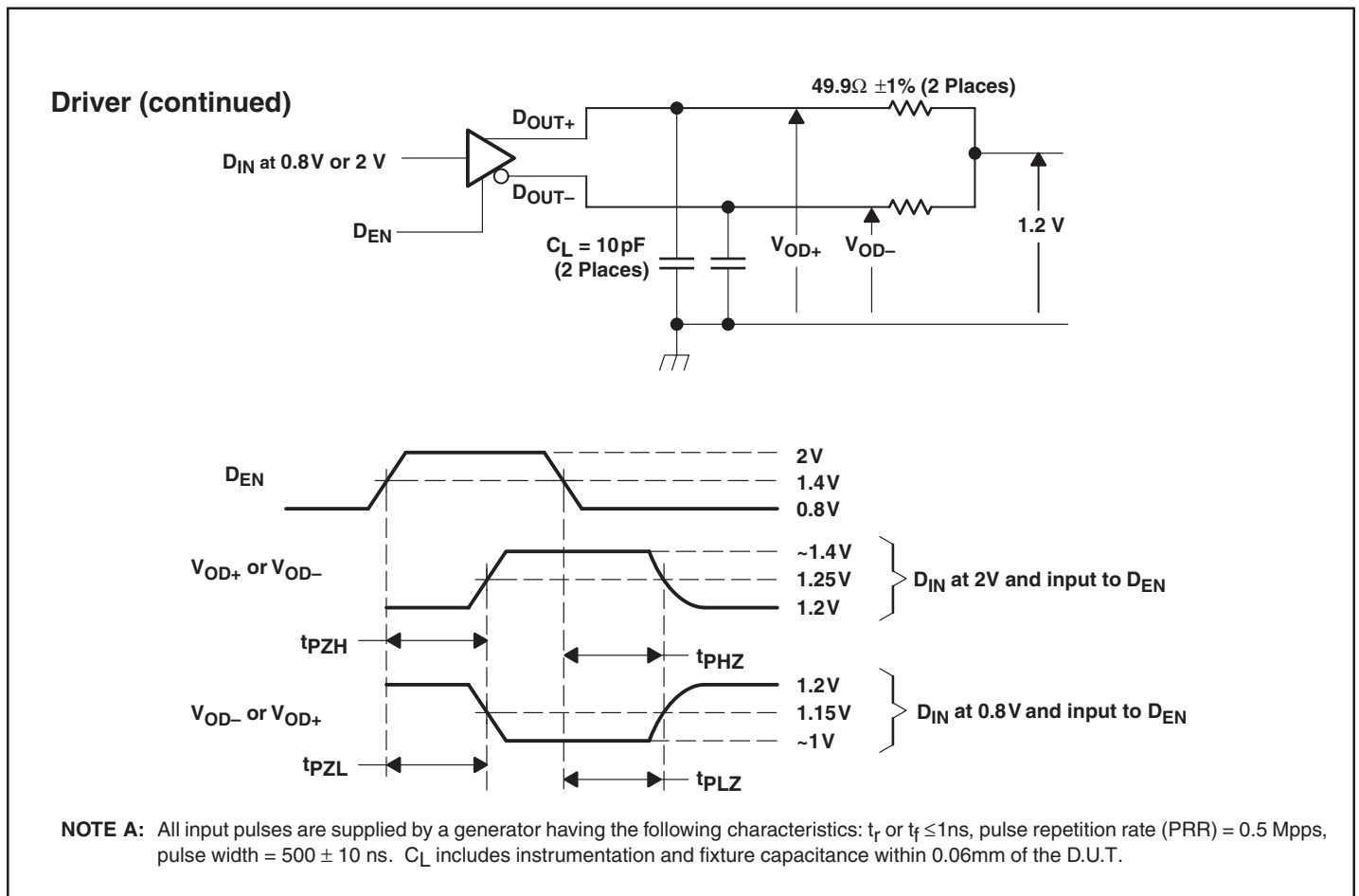


Figure 3. Test Circuit and Definitions for the Driver Common-Mode Output Voltage

**Parameter Measurement Information (continued)**



**Figure 4. Enable and Disable Timing Circuit and Definitions**

Parameter Measurement Information (continued)

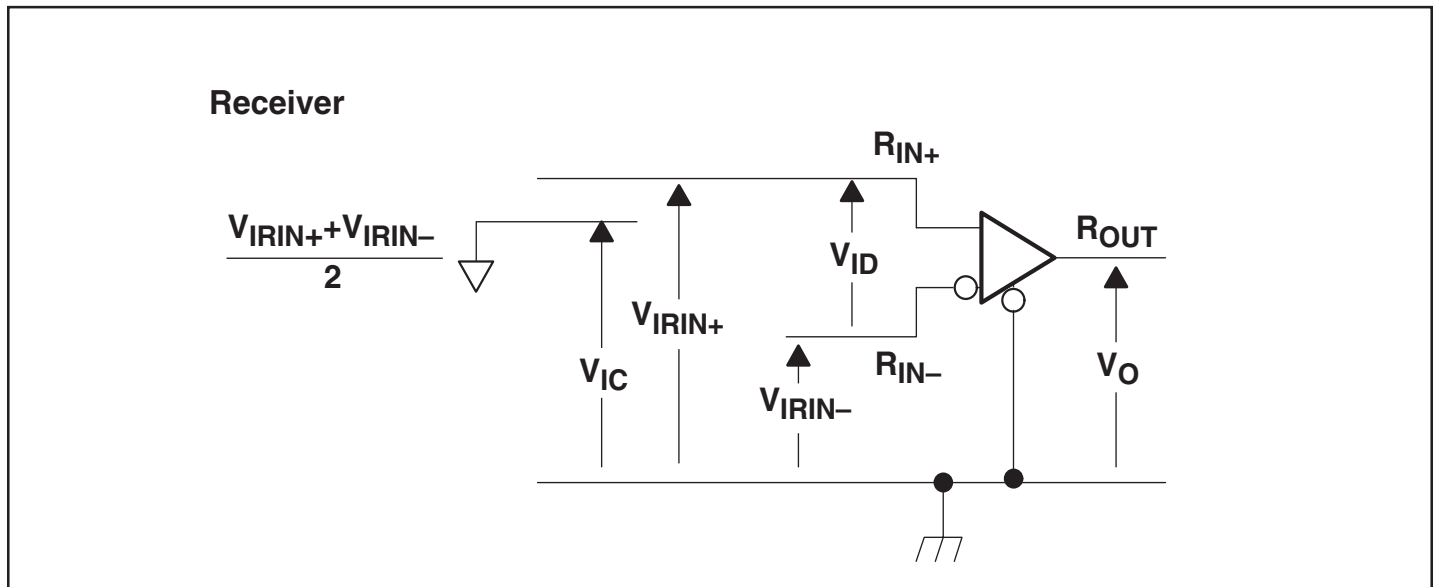
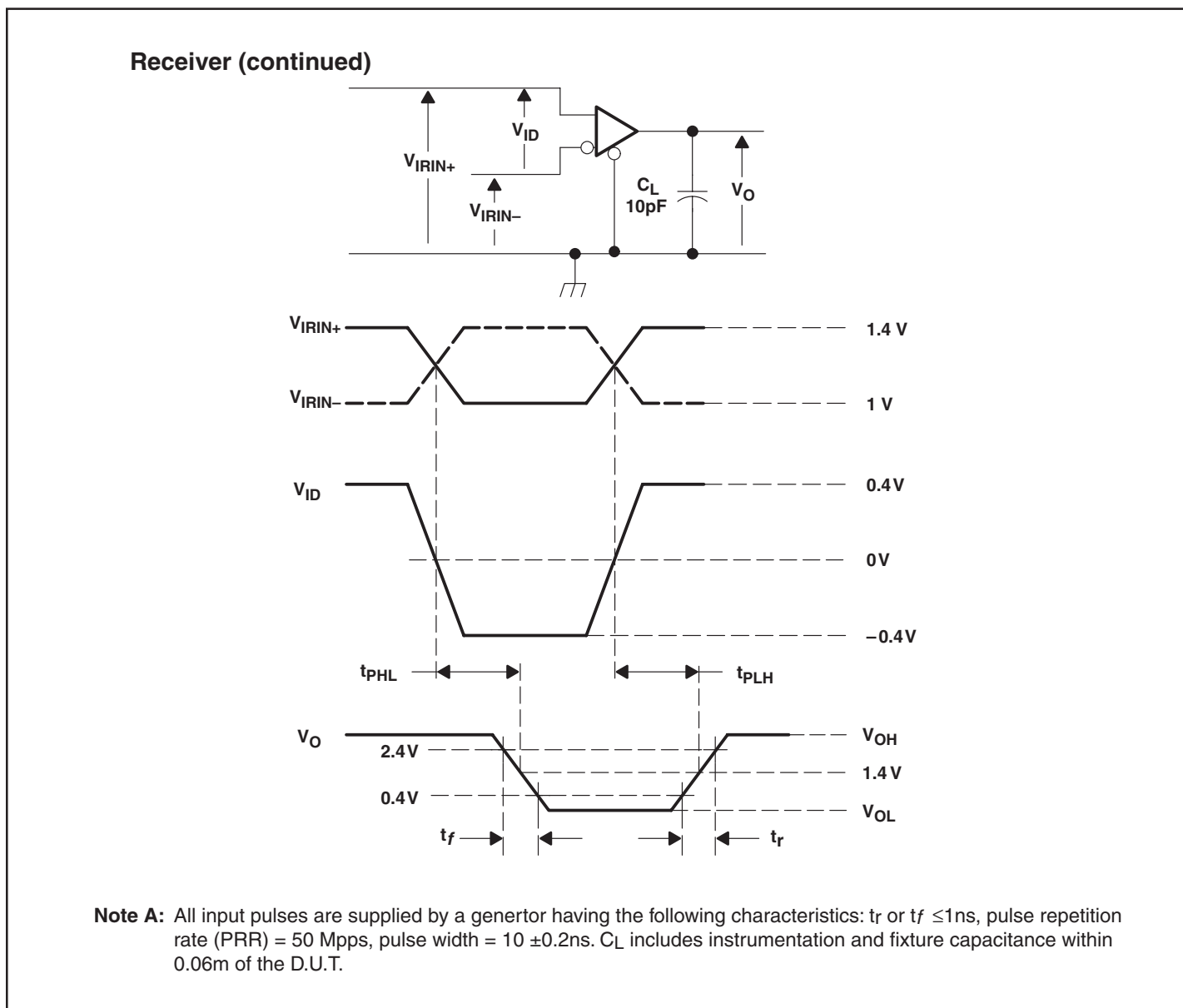


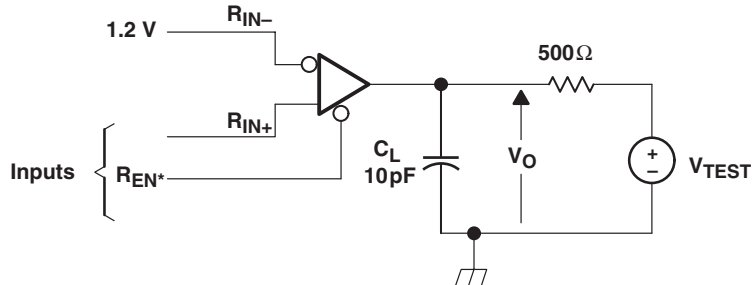
Figure 5. Receiver Voltage Definitions

Table 1. Receiver Minimum and Maximum Input Threshold Test Voltages

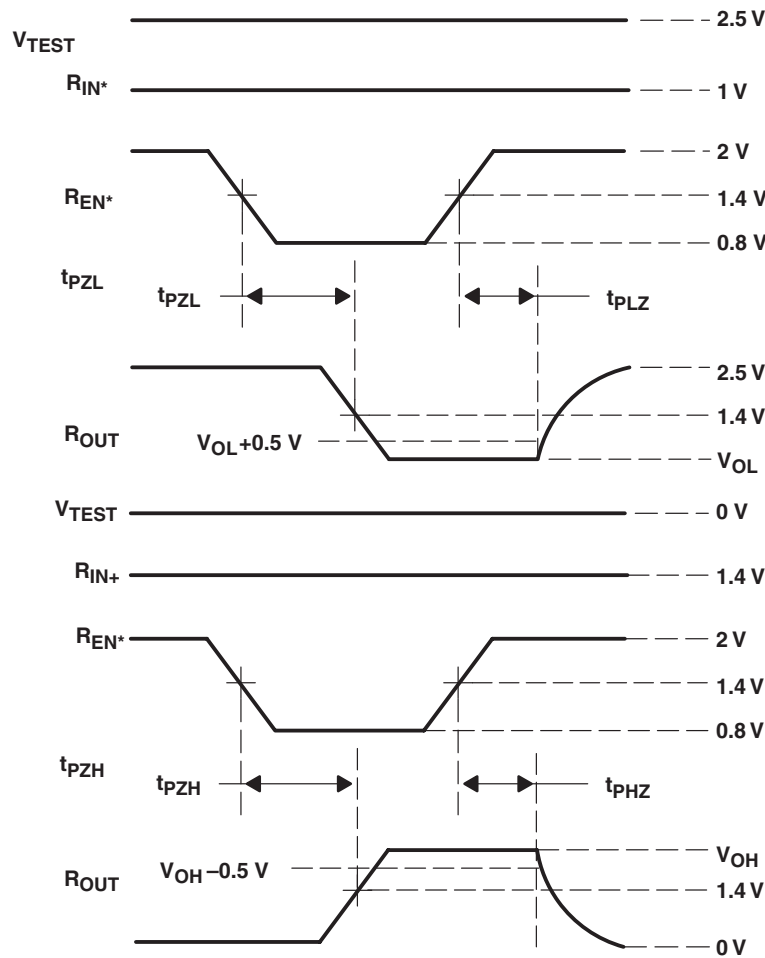
APPLIED VOLTAGES (V)		RESULTING DIFFERENTIAL INPUT VOLTAGE (mV)	RESULTING COMMON-MODE INPUT VOLTAGE (V)
$V_{IRIN+}$	$V_{IRIN-}$	$V_{ID}$	$V_{IC}$
1.225	1.175	50	1.2
1.175	1.225	-50	1.2
2.375	2.325	50	2.35
2.325	2.375	-50	2.35
0.1	0	50	0.05
0	0.05	-50	0.05
1.5	0.9	600	1.2
0.9	1.5	-600	1.2
2.4	1.8	600	2.1
1.8	2.4	-600	2.1
0.6	0	600	0.3
0	0.6	-600	0.3



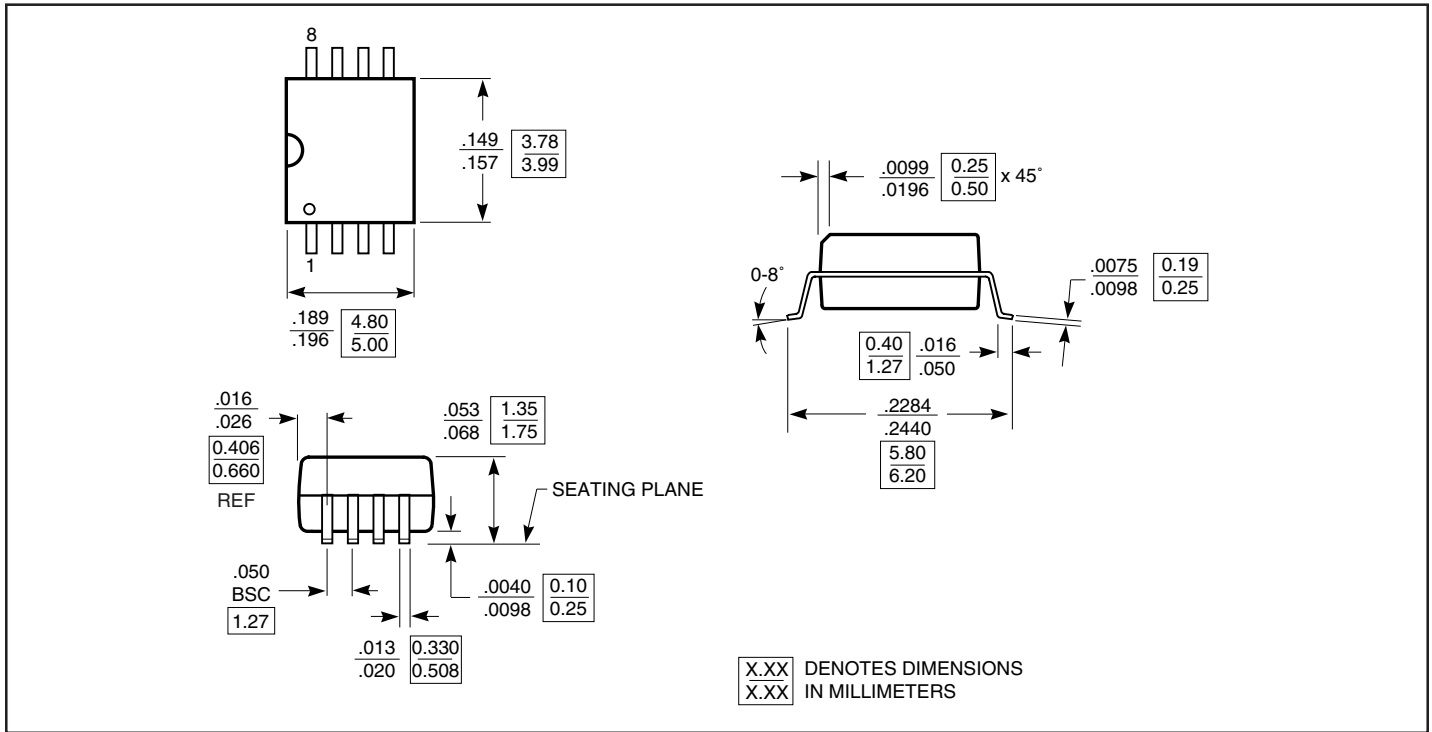
**Parameter Measurement Information (continued)**

**Figure 6. Timing Test Circuit and Waveforms**

**Parameter Measurement Information**
**Receiver (continued)**


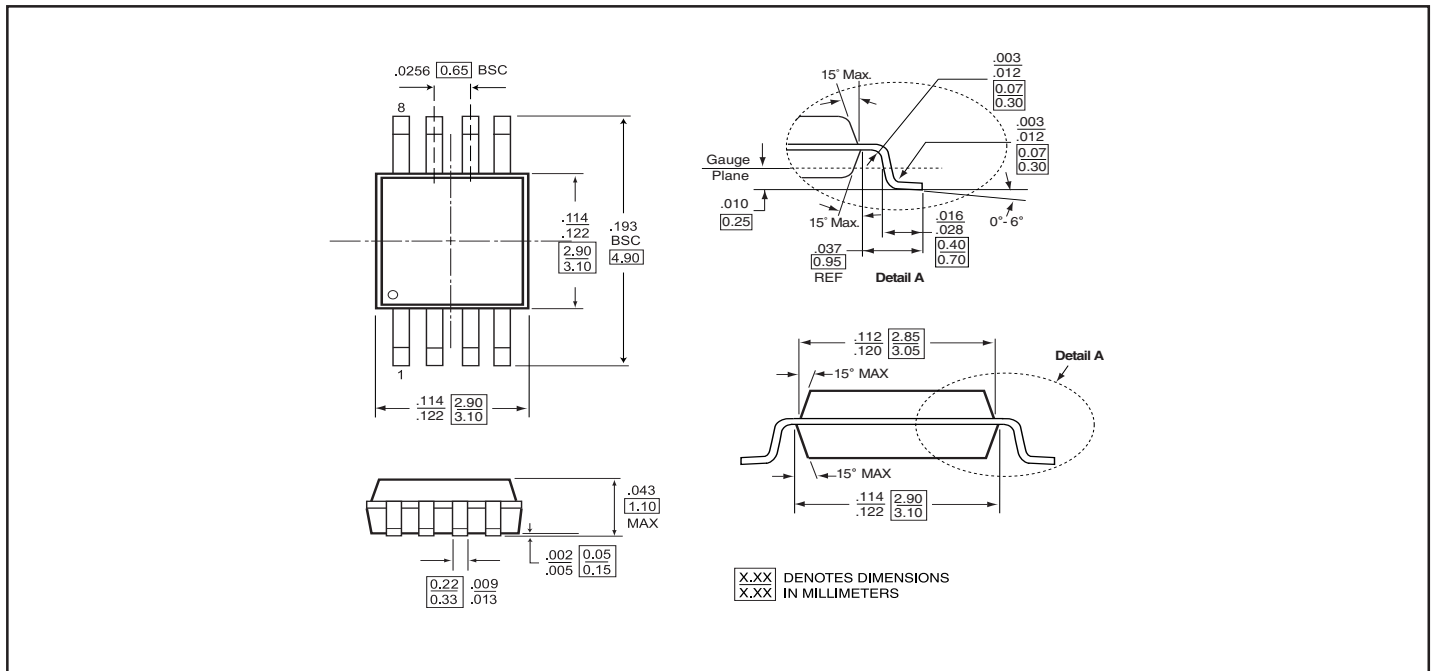
**NOTE A:** All input pulses are supplied by a generator having the following characteristics:  $t_r$  or  $t_f \leq 1\text{ns}$ , pulse repetition rate (PRR) = 0.5 Mpps, pulse wide =  $500 \pm 10\text{ns}$ .  $C_L$  includes instrumentation and fixture capacitance within 0.06m of the D.U.T.


**Figure 7. Enable/Disable Time Test Circuit and Waveforms**

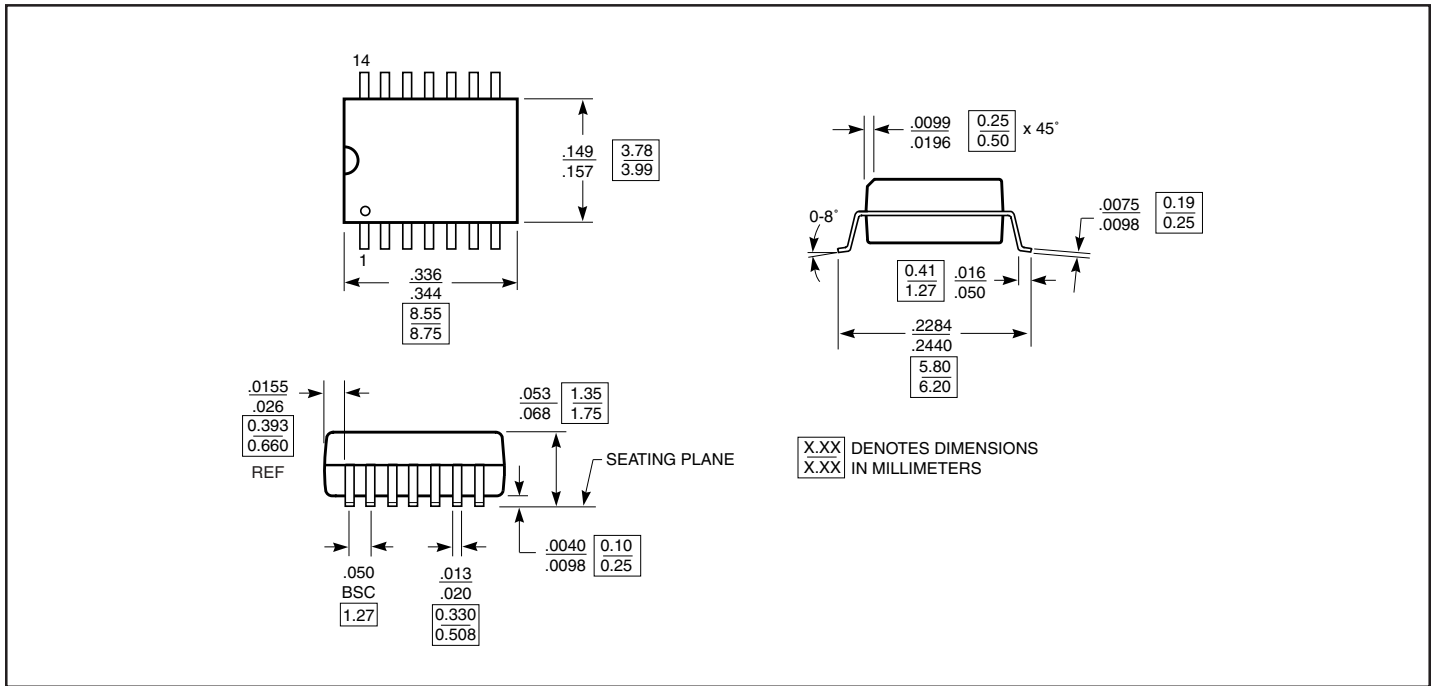
**Packaging Mechanical: 8-Pin SOIC (W)**



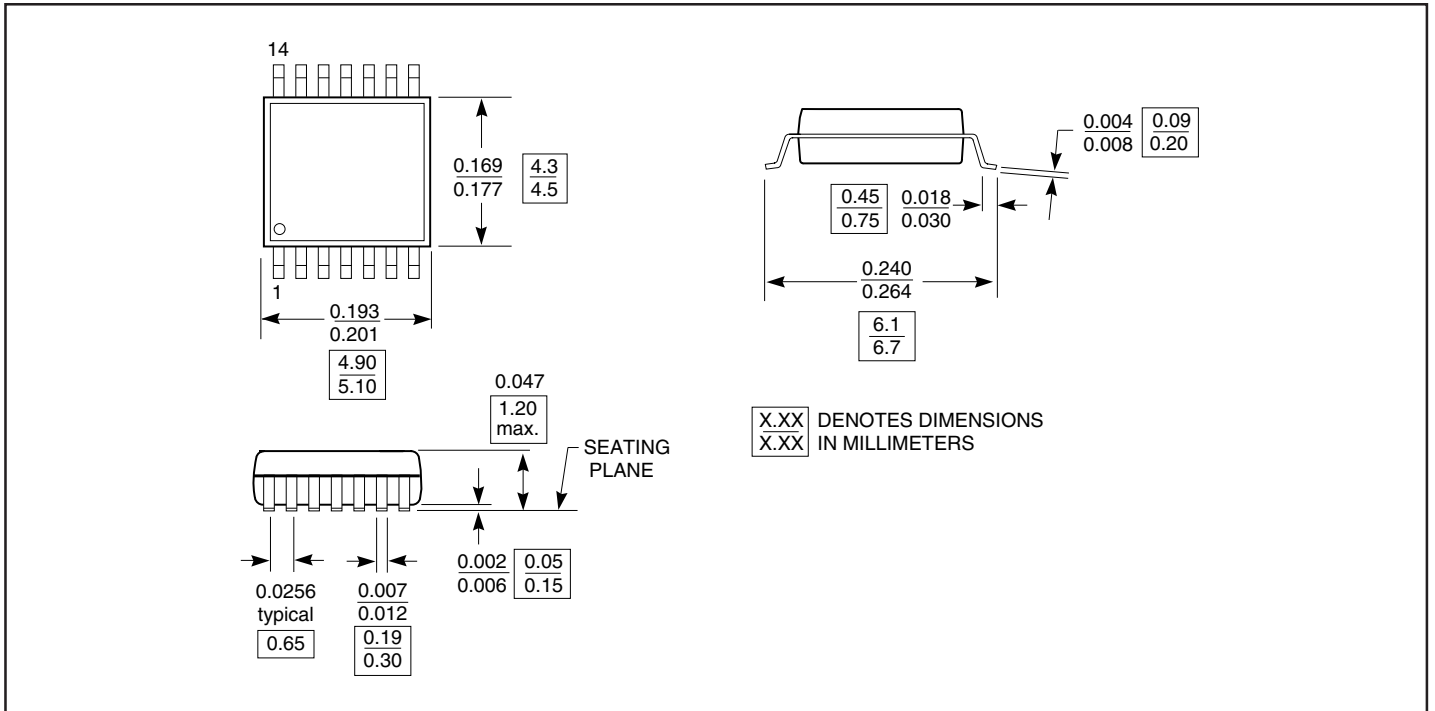
**Packaging Mechanical: 8-Pin MSOP (U)**



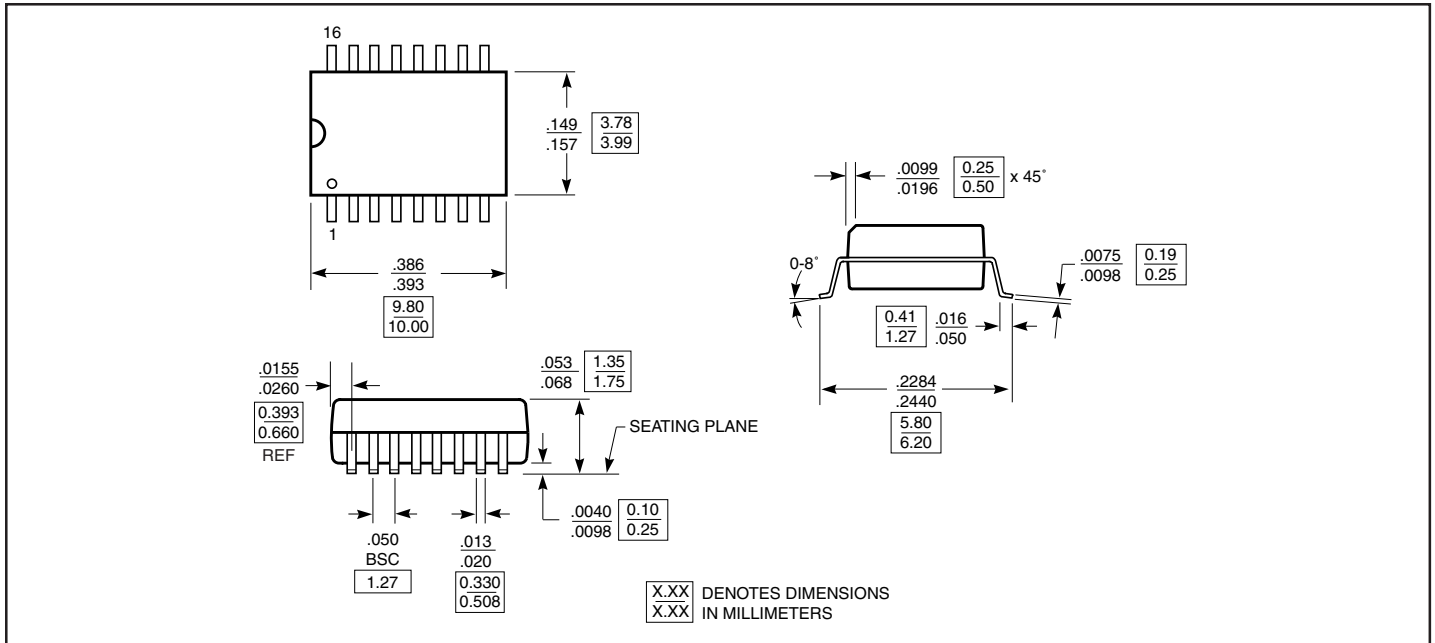
**Packaging Mechanical: 14-Pin SOIC (W)**



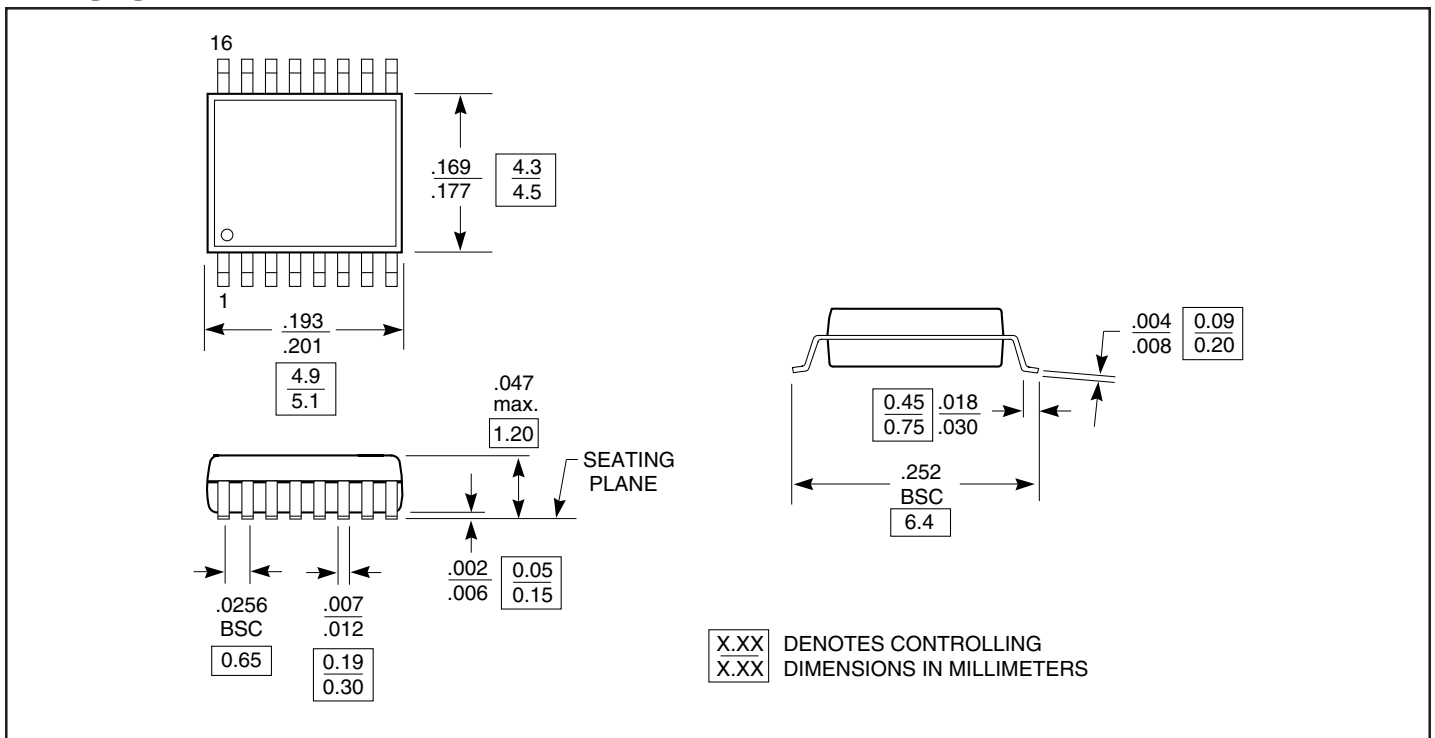
**Packaging Mechanical: 14-Pin TSSOP(L)**



**Packaging Mechanical: 16-Pin SOIC(W)**



**Packaging Mechanical: 16-Pin TSSOP (L)**



**Ordering Information**

Ordering Code	Package Code	Package Description
PI90LV179U	U	8-pin MSOP
PI90LV179UE	U	Pb-free & Green, 8-pin MSOP
PI90LV179W	W	8-pin SOIC
PI90LV179WE	W	Pb-free & Green, 8-pin SOIC
PI90LV180W	W	14-pin SOIC
PI90LV180WE	W	Pb-free & Green, 14-pin SOIC
PI90LV180L	L	14-pin TSSOP
PI90LV180LE	L	Pb-free & Green, 14-pin TSSOP
PI90LV050L	L	16-pin TSSOP
PI90LV050LE	L	Pb-free & Green, 16-pin TSSOP
PI90LV050W	W	16-pin SOIC
PI90LV050WE	W	Pb-free & Green, 16-pin SOIC
PI90LV051L	L	16-pin TSSOP
PI90LV051LE	L	Pb-free & Green, 16-pin TSSOP
PI90LV051W	W	16-pin SOIC
PI90LV051WE	W	Pb-free & Green, 16-pin SOIC

**Notes:**

1. Thermal characteristics can be found on the company web site at [www.pericom.com/packaging/](http://www.pericom.com/packaging/)