



## PI90LVB179/PI90LVB180/ PI90LVB050/PI90LVB051

### 3.3V Boost LVDS High-Speed Differential Line Drivers and Receivers

#### Product Features

- Signaling Rates >660 Mbps (330 MHz)
- Single 3.3V Power Supply Design
- Driver:
  - $\pm 350\text{mV}$  Differential Swing into a 50 ohm load
  - Propagation Delay of 1.5ns Typ.
  - Low Voltage TTL (LVTTTL) Inputs are 5V Tolerant
  - Driver is High Impedance when Disabled or  $V_{CC} < 1.5\text{V}$
- 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  $85^{\circ}\text{C}$
- Package Options: SOIC, TSSOP, MSOP
- Bus-Terminal ESD  $\geq 12\text{kV}$

#### Product Description

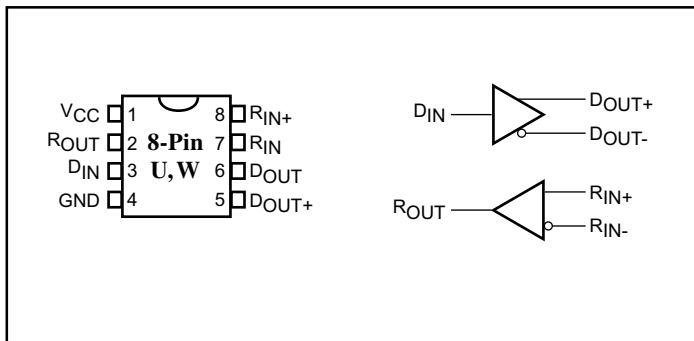
The PI90LVB179, PI90LVB180, PI90LVB050, and PI90LVB051 are differential line drivers and receivers (transceivers) that are similar to the IEEE 1596.3 SCI and ANSI/TIA/EIA-644 LVDS standards (the difference is that the driver output current is doubled). This modification enables true half-duplex operation with more than one LVDS driver or with two line transmission resistors over a 50 ohm differential transmission line. 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 into a 50-ohm load. The receivers translate a differential 350mV input signal to a 3V CMOS output level. Driver section can be independently set to a power-down and high-impedance output mode with the DEN pin (active HIGH). Receiver section is controlled by the REN\* pin (active LOW).

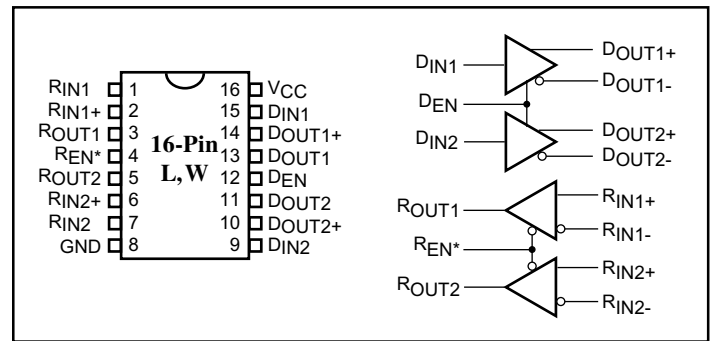
#### Applications

Applications include point-to-point and multidrop baseband data transmission over a controlled impedance media of approximately 50 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.

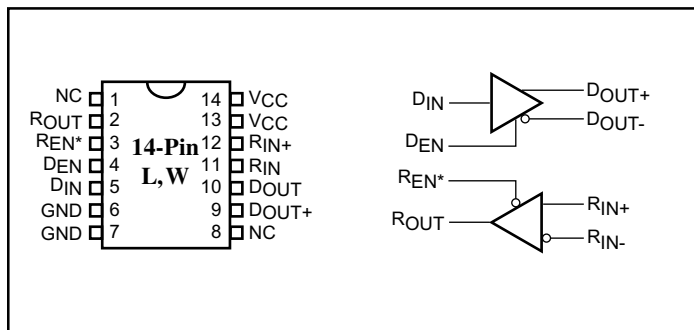
#### PI90LVB179



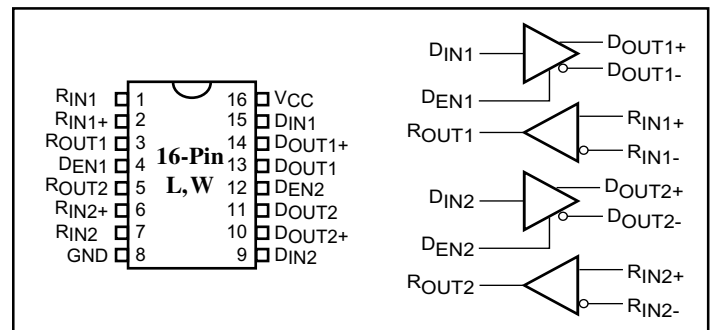
#### PI90LVB050



#### PI90LVB180



#### PI90LVB051



### Function Tables

#### PI90LVB179 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

#### PI90LVB179 Driver

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

#### PI90LVB180/PI90LVB050/PI90LVB051 Receiver

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

#### PI90LVB180/PI90LVB050/PI90LVB051 Driver

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$		$2.4 -  V_{ID} /2$	°C
			$V_{CC} - 0.8$	
Operating Free Air Temperature $T_A$	-40		85	

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

Parameter		Test Condition	Min.	Typ. <sup>†</sup>	Max.	Units
I <sub>CC</sub> * Supply Current	PI90LVB179	No receiver load, Driver R <sub>L</sub> = 50 ohms		10	14	mA
	PI90LVB180	Driver and receiver enabled. No receiver load, Driver R <sub>L</sub> = 50 ohms		10.5	14	
		Driver disabled, Receiver disabled, R <sub>L</sub> = 50 ohms		1	1.5	
		Driver disabled, Receiver enabled, No load		0.9	1.1	
		Disabled		1.3	1.7	
		PI90LVB050	Driver and receivers enabled. No receiver loads, Driver R <sub>L</sub> = 50 ohms		20.5	
	Drivers disabled, Receivers disabled, R <sub>L</sub> = 50 ohms			3.1	3.7	
	Drivers disabled, Receivers enabled, No loads			1.0	1.2	
	Disabled			1.2	1.5	
	PI90LVB051	Drivers enabled, No receiver loads, Driver R <sub>L</sub> = 50 ohms		20.5	24.7	
Drivers disabled, No loads			1.0	1.2		

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

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

**Driver 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> = 50 ohms See Figures 1 and 2	247	420	520	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	165	
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	-12	mA
		V <sub>OD</sub> = 0V		-8	-15	
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			3	10.5	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			pF

†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.†	Max.	Units	
t <sub>PLH</sub>	Propagation delay time, low-to-high-level output	R <sub>L</sub> = 50 ohms C <sub>L</sub> = 10pF See Figure 2		2.0	2.6	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			0.4	0.6		
t <sub>f</sub>	Differential output signal fall time			0.4	0.6		
t <sub>sk(p)</sub>	Pulse skew (t <sub>PHL</sub> - t <sub>PLH</sub> )				200	310	ps
t <sub>sk(o)</sub>	Channel-to-channel output skew‡				90	160	
t <sub>sk(pp)</sub>	Part-part-part skew**				0.9		
t <sub>PZH</sub>	Propagation delay time, high-impedance-to-high-level output	See Figure 7		3.3	5	ns	
t <sub>PZL</sub>	Propagation delay time, high-impedance-to-low-level output			2.0	3.3		
t <sub>PHZ</sub>	Propagation delay time, high-level-to-high-impedance output			1.7	3.3		
t <sub>PLZ</sub>	Propagation delay time, low-level-to-high-impedance output			1.7	3.3		

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

‡t<sub>sk(o)</sub>: the 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)

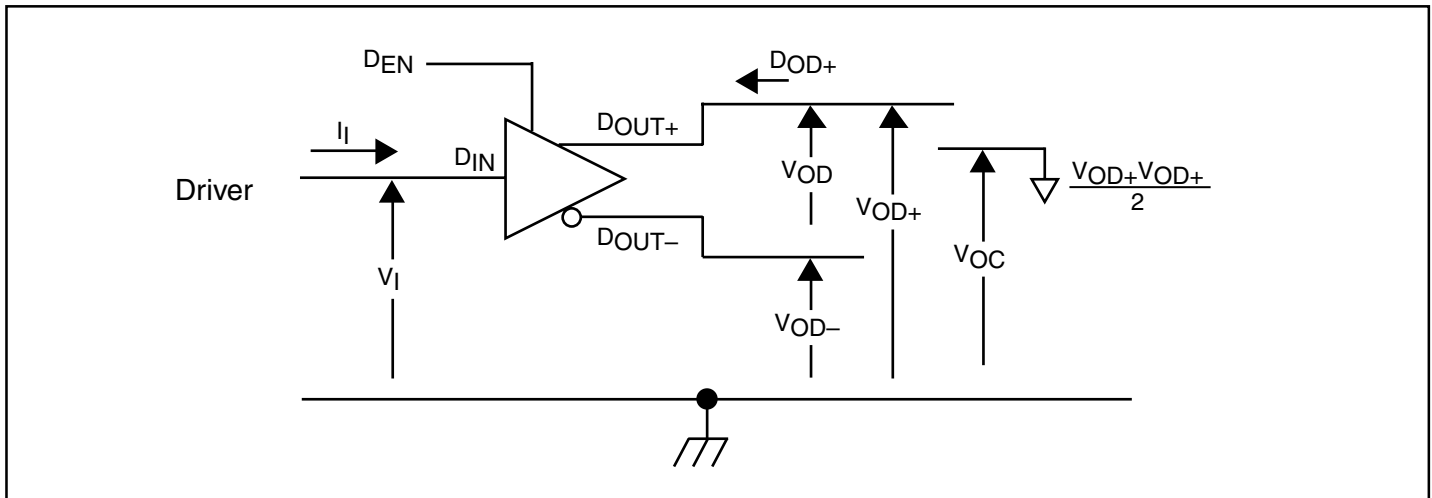
**Receiving Switching Characteristics** (Over recommended operating conditions unless otherwise noted).

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		1.9	2.9	ns
t <sub>PHL</sub>	Propagation delay time, high-to-low-level output			2.4	3.3	
t <sub>sk(p)</sub>	Pulse skew (t <sub>PHL</sub> - t <sub>PLH</sub> )			0.1	0.4	
t <sub>sk(pp)**</sub>	Part-part-part skew**				1.3	
t <sub>sk(o)</sub>	Channel-to-channel skew			40	80	ps
t <sub>r</sub>	Output signal rise time				1.1	1.7
t <sub>f</sub>	Output signal fall time			1.3	2.1	
t <sub>PZH</sub>	Propagation delay time, high-level-to-high-impedance output	See Figure 7		1.6	2.4	ns
t <sub>PZL</sub>	Propagation delay time, low-level-to-low-impedance output			4.1	5.9	
t <sub>PHZ</sub>	Propagation delay time, high-impedance-to-high-level output			2.5	3.2	
t <sub>PLZ</sub>	Propagation delay time, low-impedance-to-high-level output			6.0	7.8	

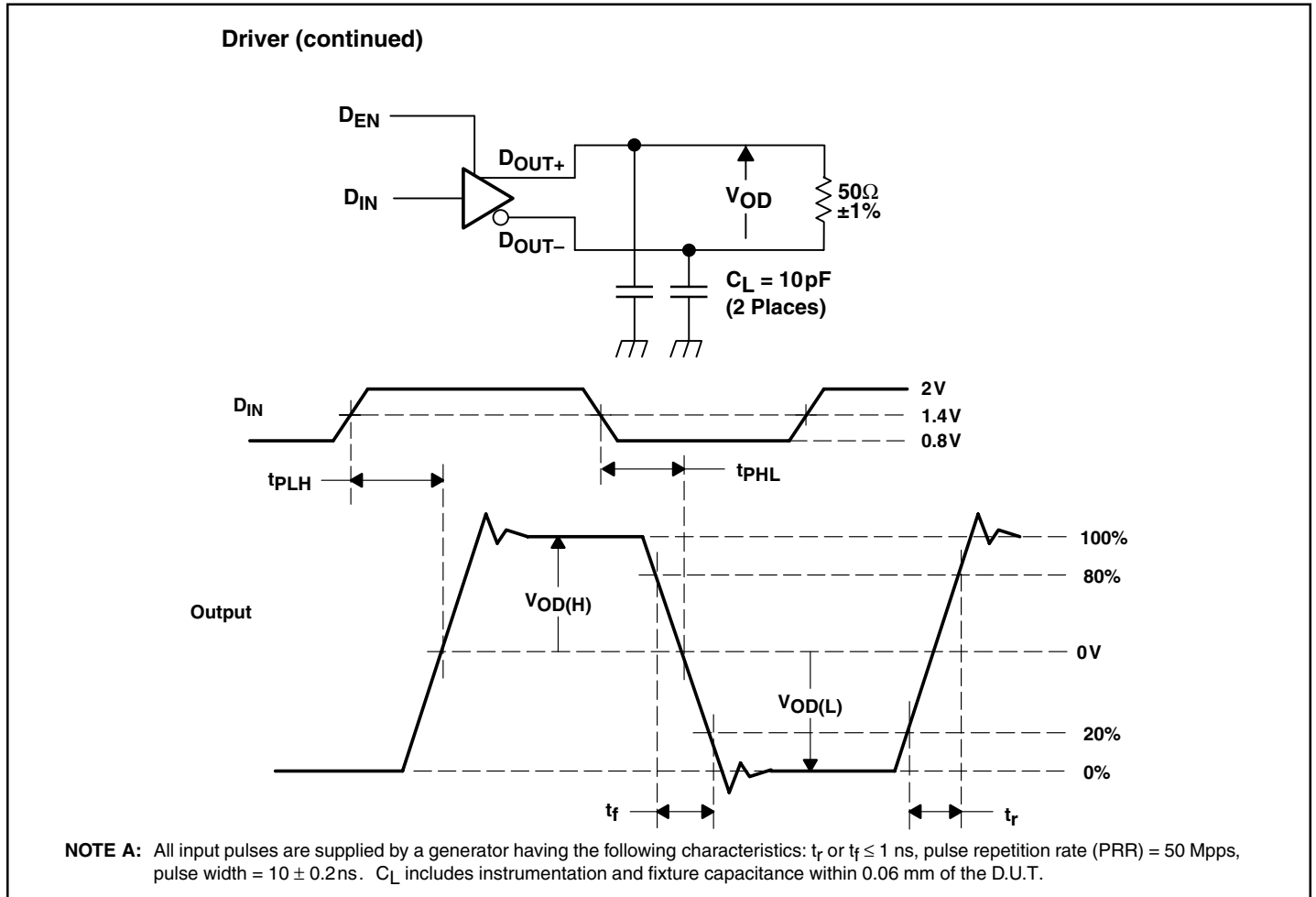
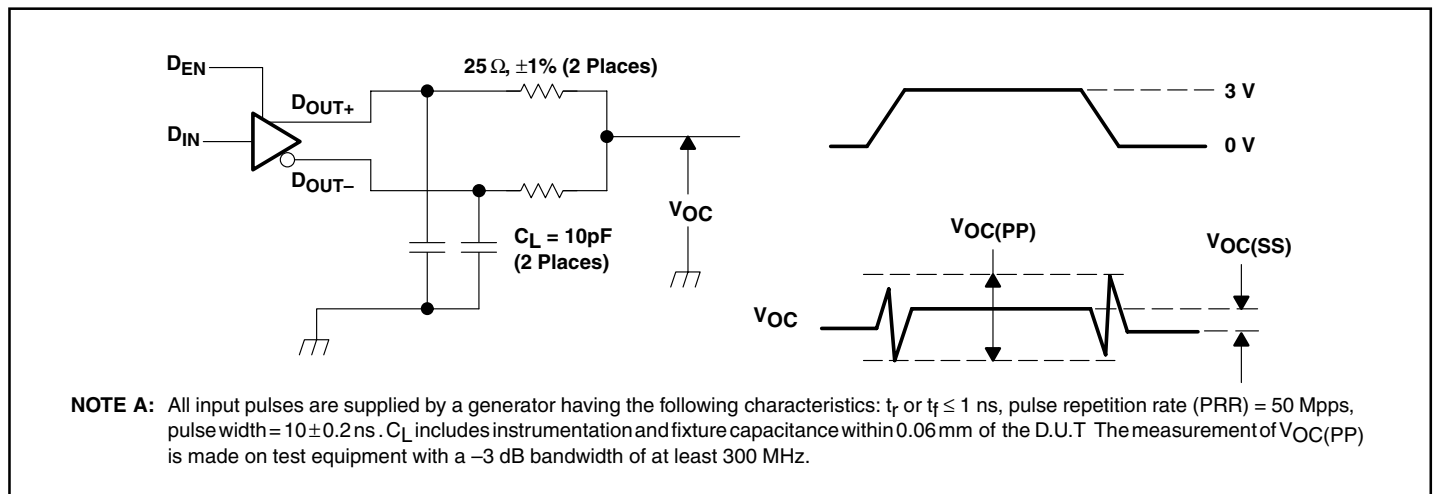
<sup>†</sup>All typical values are at 25°C with a 3.3V supply

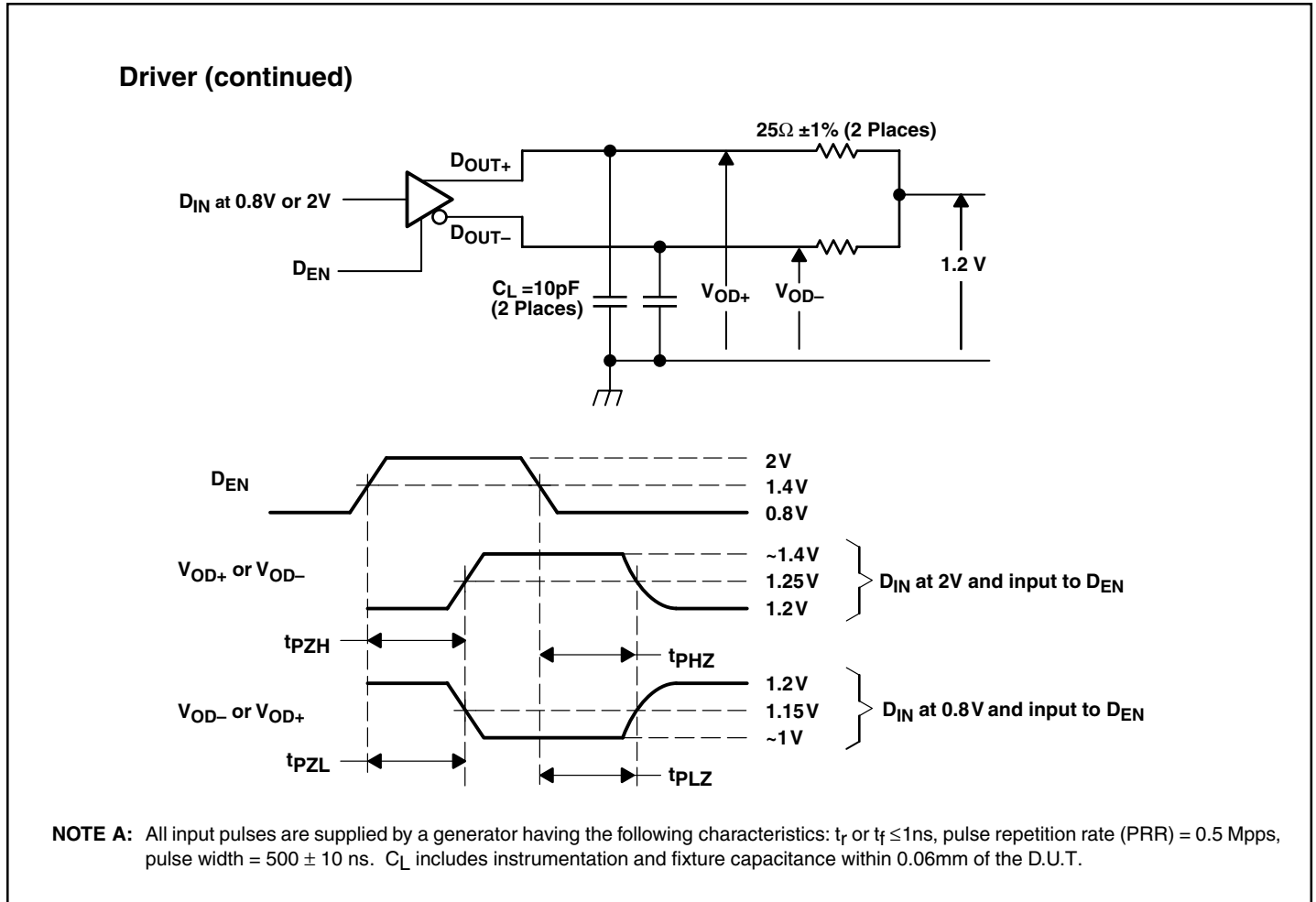
\*\*t<sub>sk(pp)</sub> is magnitude of the difference in propagation delay times between any specific terminals of two devices (all things being equal)

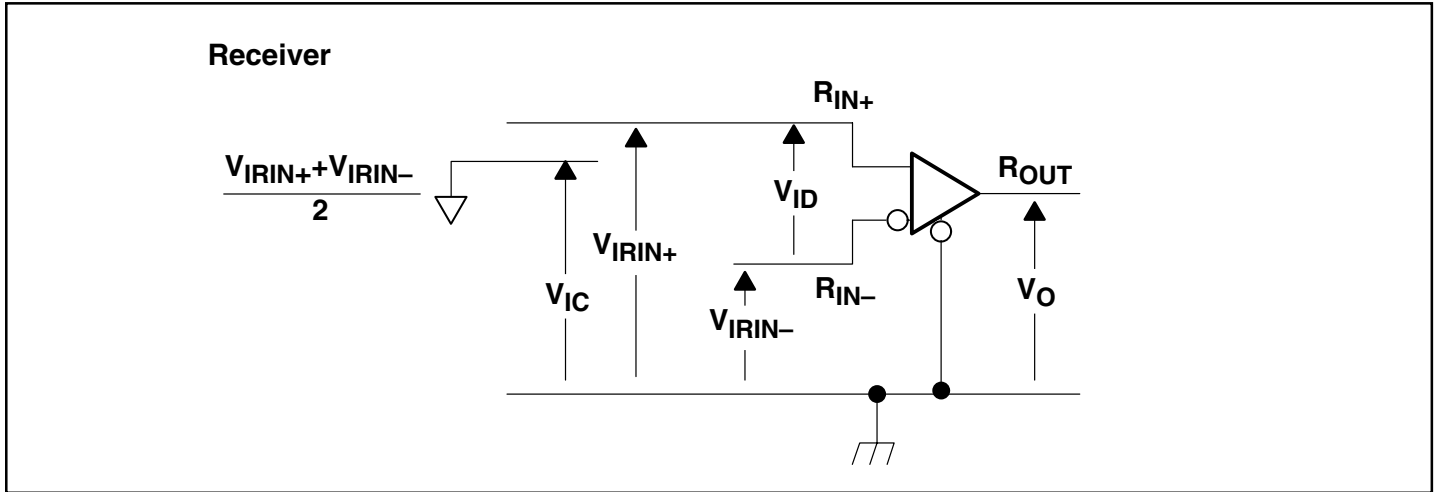
**Parameter Measurement Information**



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

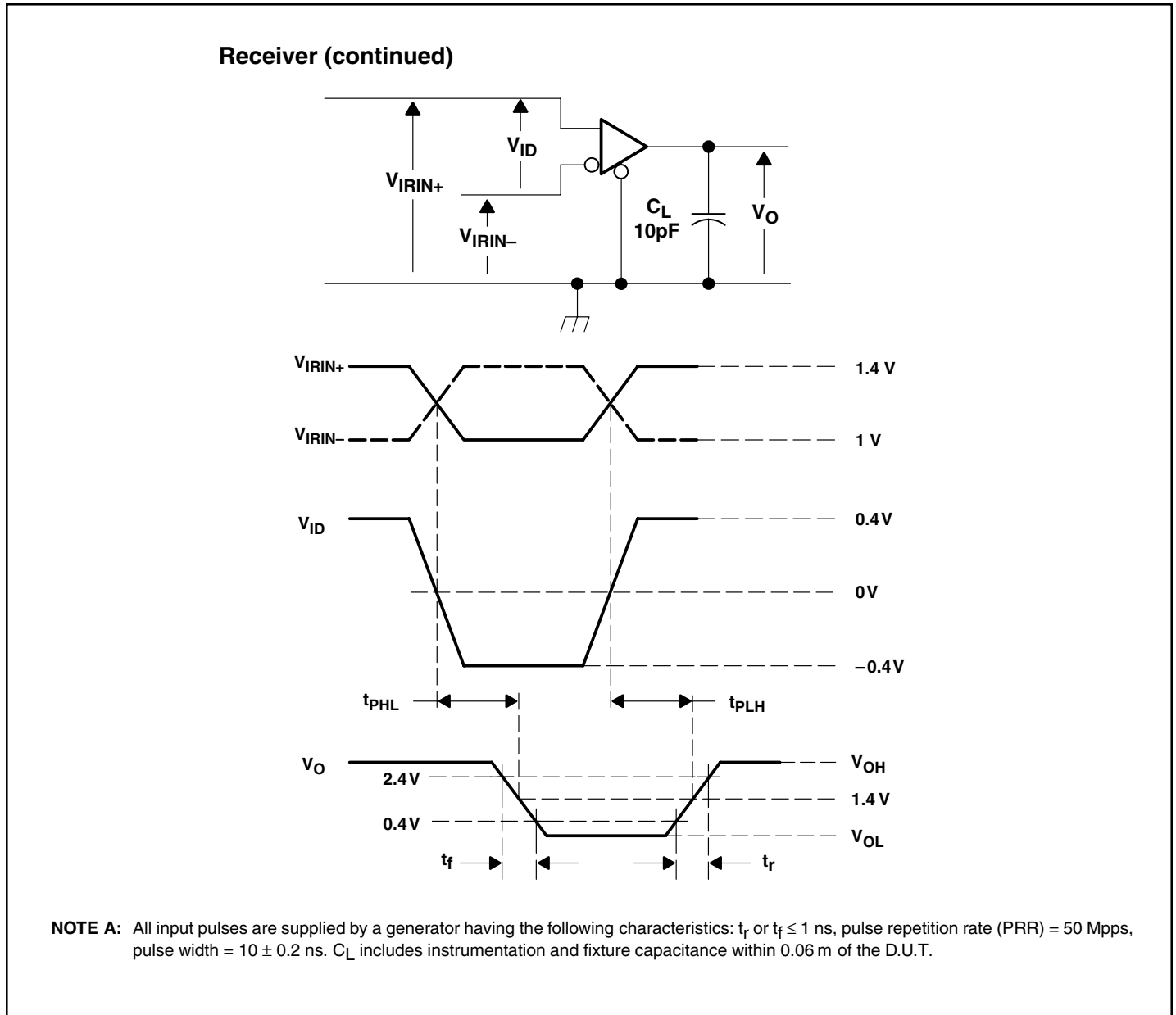
**Parameter Measurement Information**

**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**

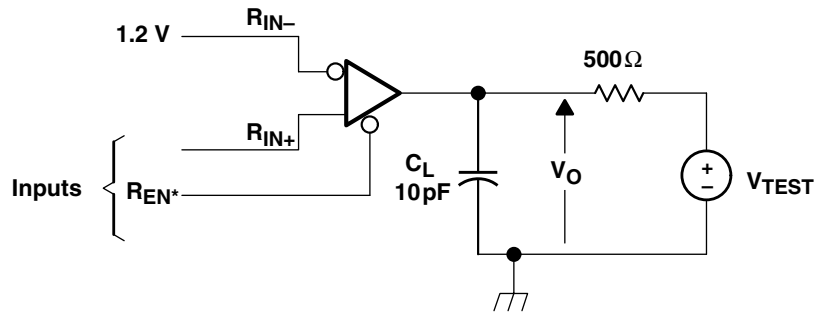
**Parameter Measurement Information**

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

**Parameter Measurement Information**

**Figure 5. Receiver Voltage Definitions**
**Table 1. Receiver Minimum and Maximum Input Threshold Test Voltages**

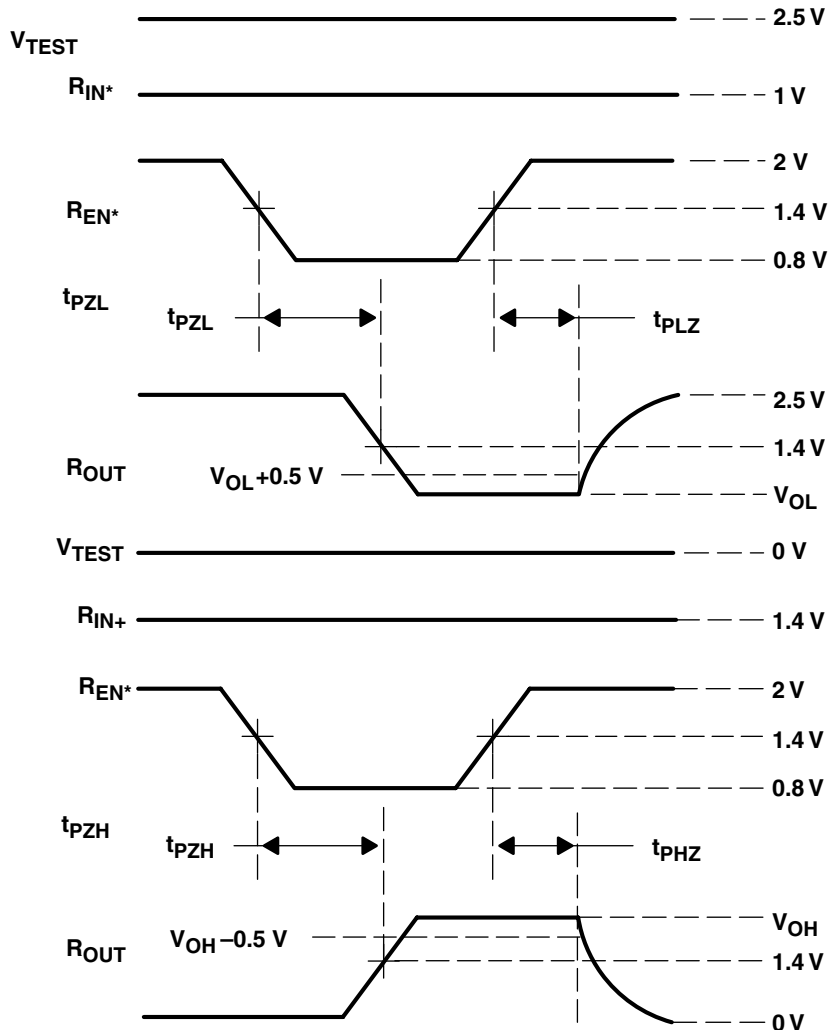
APPLIED VOLTAGES (V)		RESULTING DIFFERENTIAL INPUT VOLTAGE (mV)	RESULTING COMMON-MODE INPUT VOLTAGE (V)
$V_{IRIN+}$	$V_{IRIN-}$	$V_{ID}$	$V_{IC}$
1.225	1.175	50	1.2
1.175	1.225	-50	1.2
2.375	2.325	50	2.35
2.325	2.375	-50	2.35
0.1	0	50	0.05
0	0.05	-50	0.05
1.5	0.9	600	1.2
0.9	1.5	-600	1.2
2.4	1.8	600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



**Parameter Measurement Information**

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

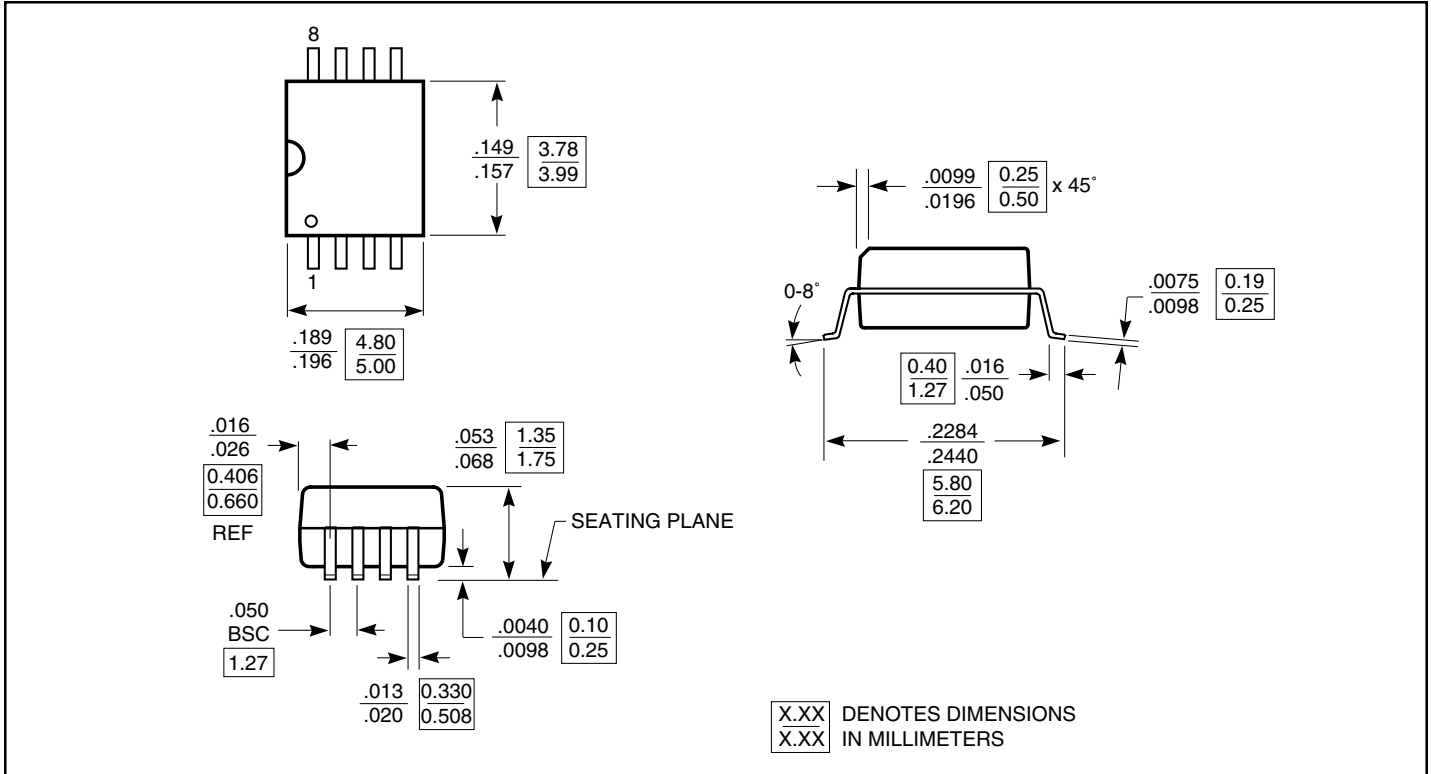
**Parameter Measurement Information**
**Receiver (continued)**


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

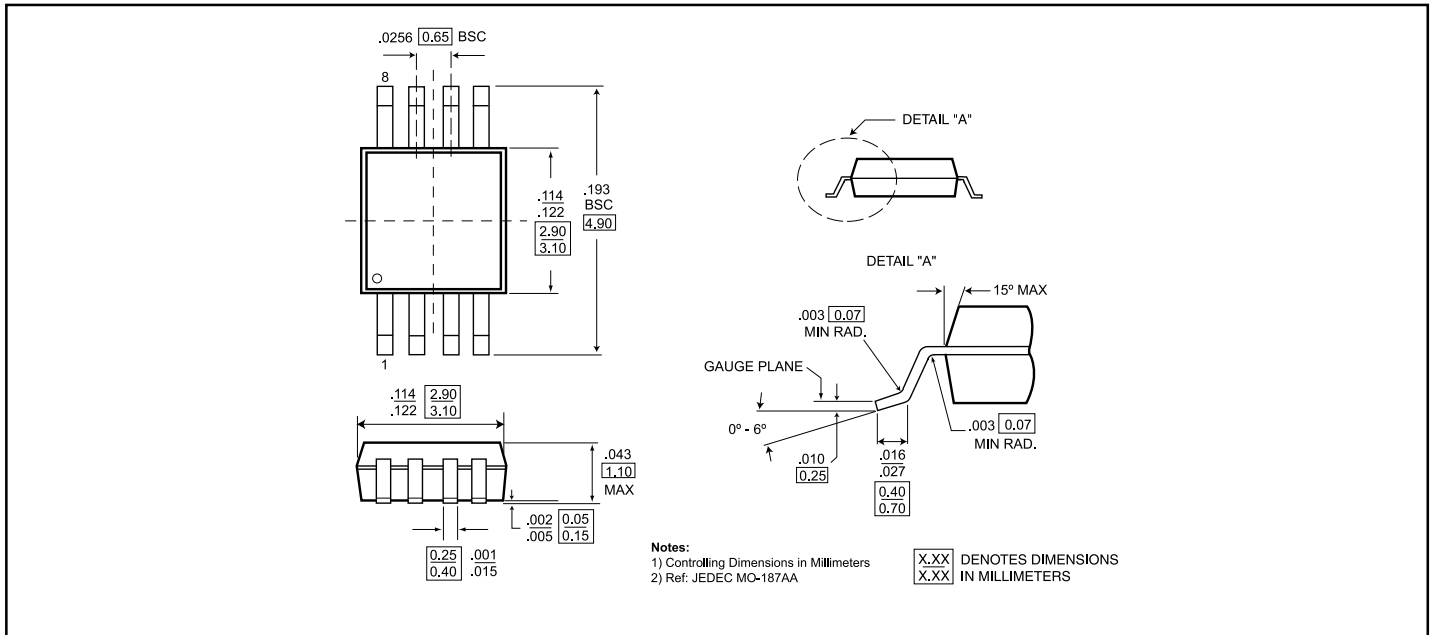


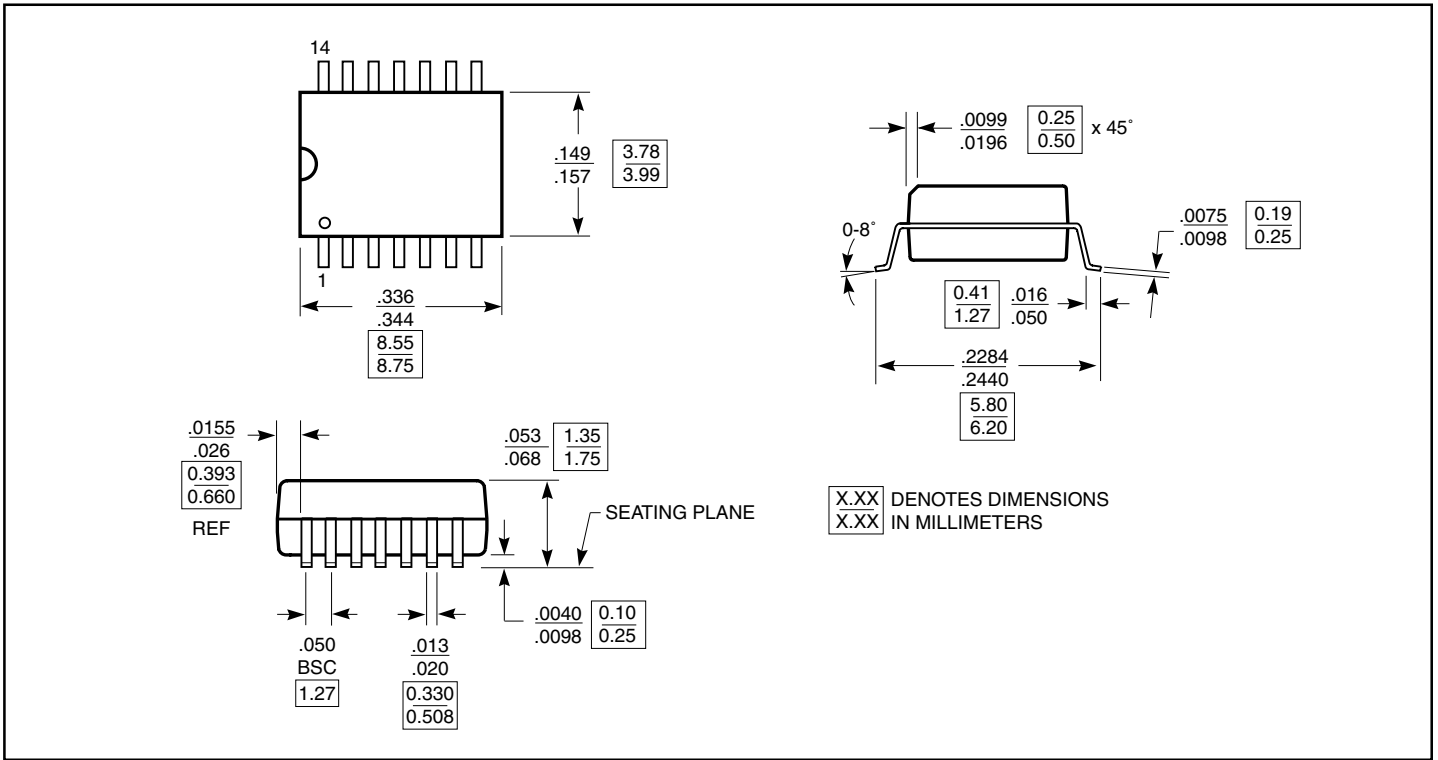
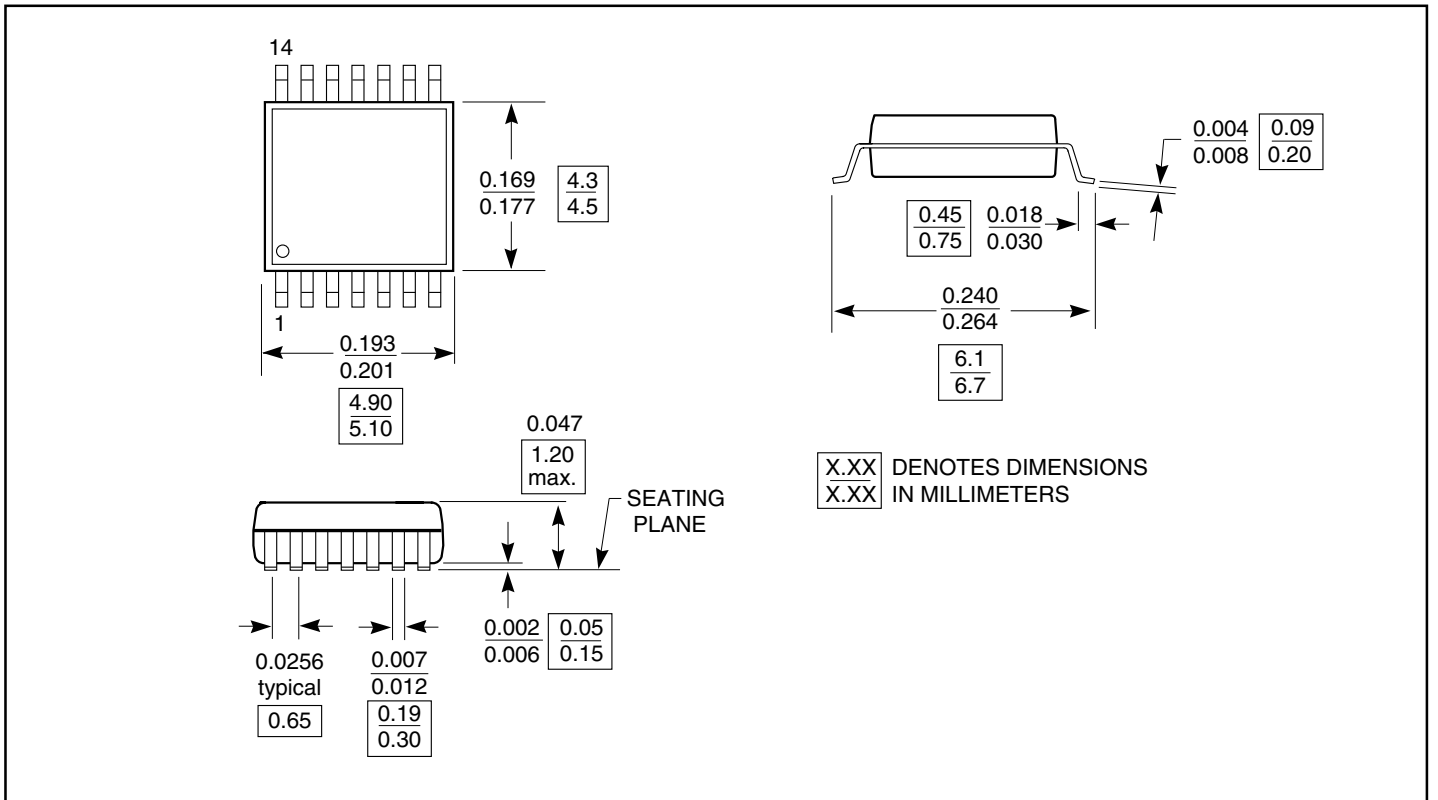
**Figure 7. Enable/Disable Time Test Circuit and Waveforms**

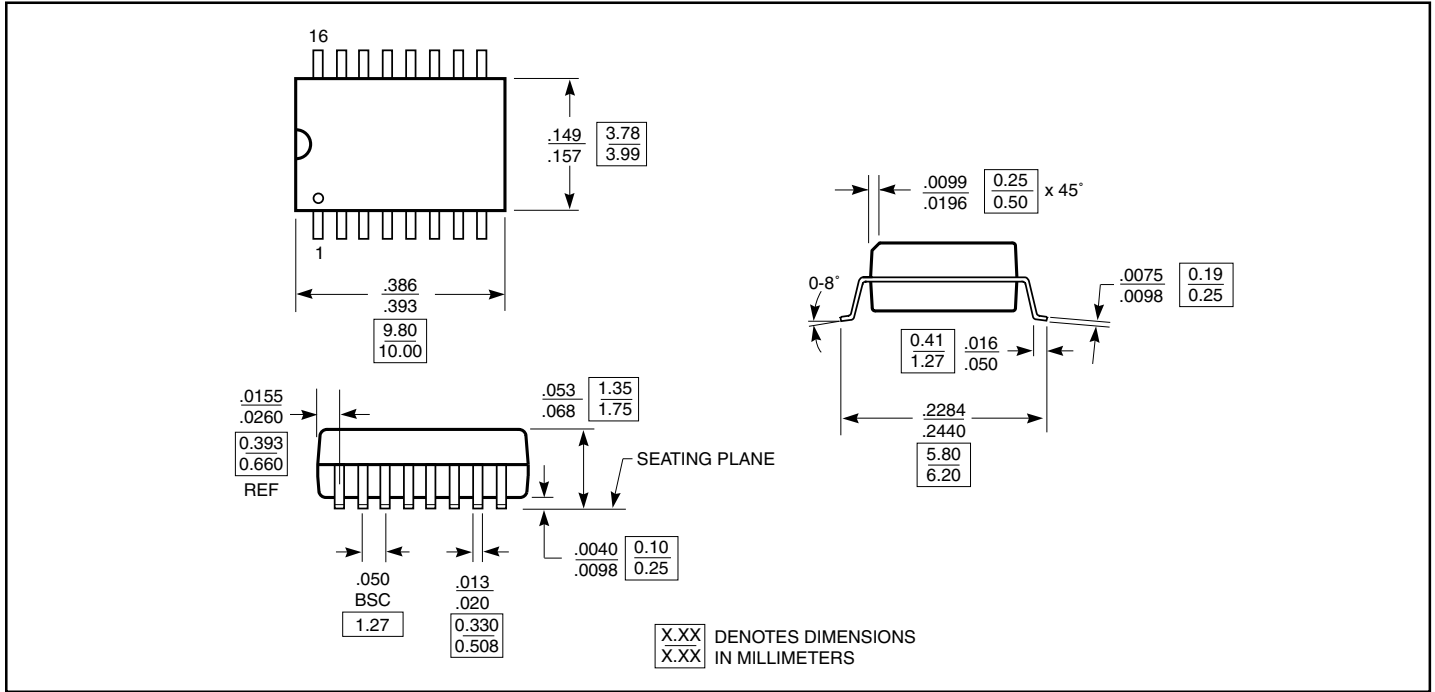
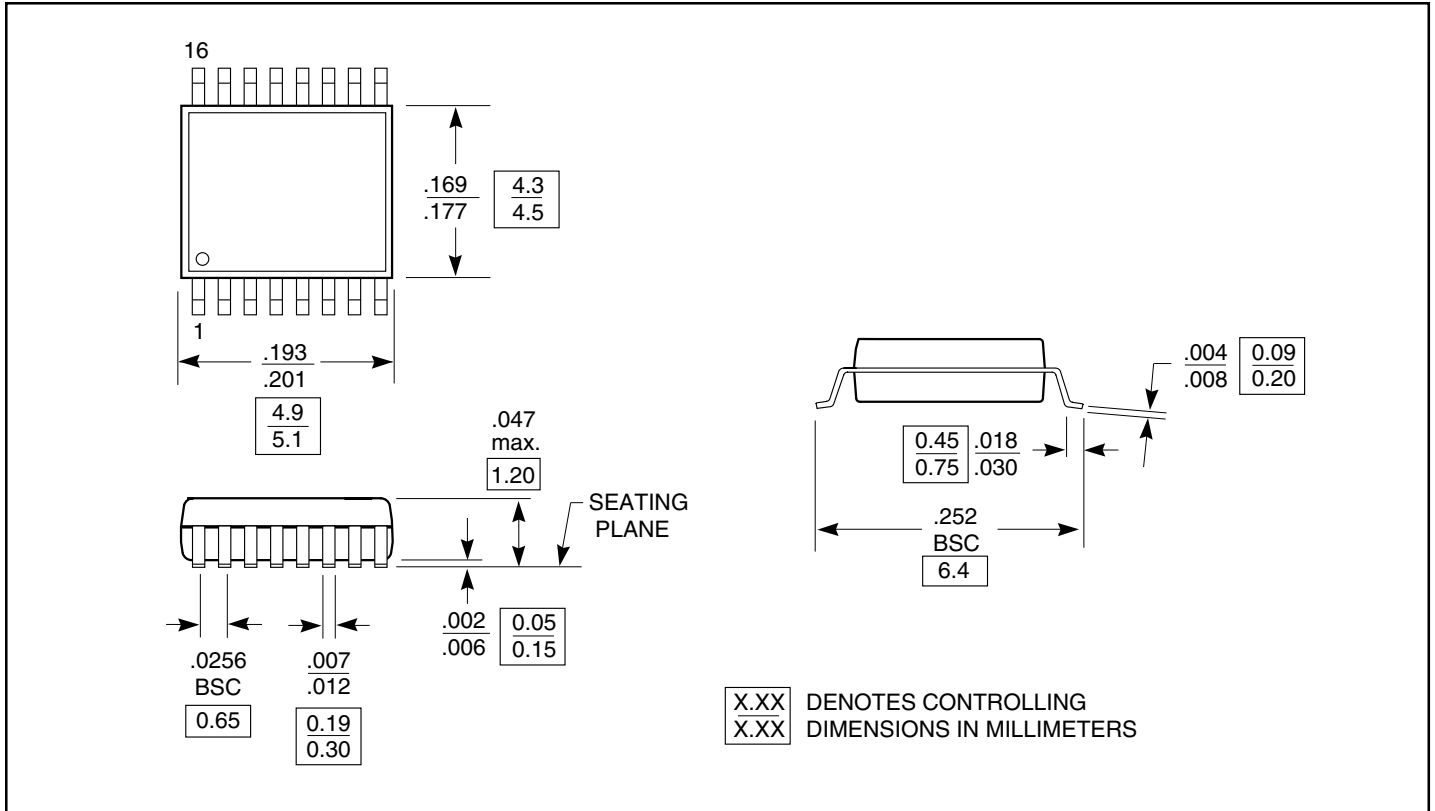
### 8-Pin SOIC W Package



### 8-Pin Mini Small Outline U Package (MSOP)



**14-Pin SOIC (150 Mil) W Package**

**14-Pin TSSOP (4.4mm wide) L Package**


**16-Pin SOIC (150 Mil) W Package**

**16-Pin TSSOP (4.4mm wide) L Package**




### Ordering Information

Part	Pin - Package	Temperature
PI90LVB179W	8-SOIC	-40°C to +85°C
PI90LVB180W	14-SOIC	-40°C to +85°C
PI90LVB050W	16-SOIC	-40°C to +85°C
PI90LVB051W	16-SOIC	-40°C to +85°C
PI90LVB179U	8-MSOP	-40°C to +85°C
PI90LVB180L	14-TSSOP	-40°C to +85°C
PI90LVB050L	16-TSSOP	-40°C to +85°C
PI90LVB051L	16-TSSOP	-40°C to +85°C