



# PI90LV179, PI90LV180, PI90LV050, PI90LV051

## 3.3V 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 100-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
- Meets or Exceeds IEEE 1596.3 SCI Standard
- Meets or Exceeds ANSI/TIA/EIA-644 LVDS Standard
- Bus-Terminal ESD exceeds 12kV

### Product Description

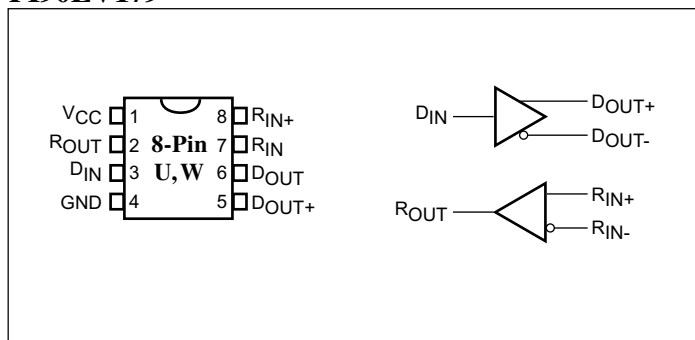
The PI90LV179, PI90LV180, PI90LV050, and PI90LV051 are differential line drivers and receivers (transceivers) that are compliant with the IEEE 1596.3 SCI and ANSI/TIA/EIA-644 LVDS standards. These devices use low-voltage differential signaling (LVDS) to achieve data rates in excess of 660 Mbps while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

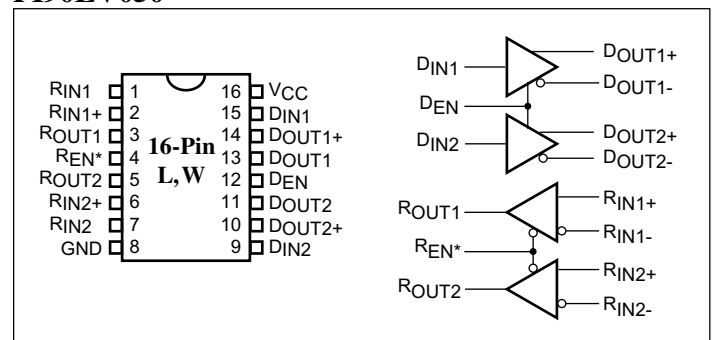
### Applications

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.

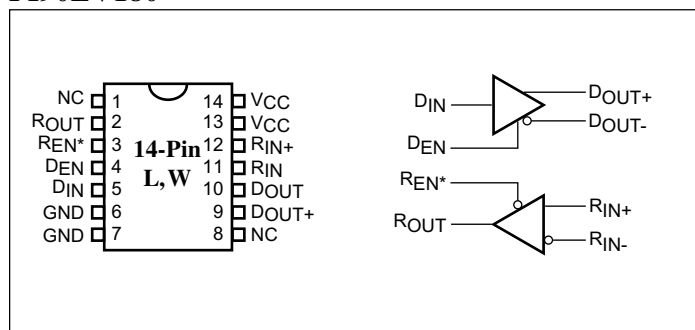
### PI90LV179



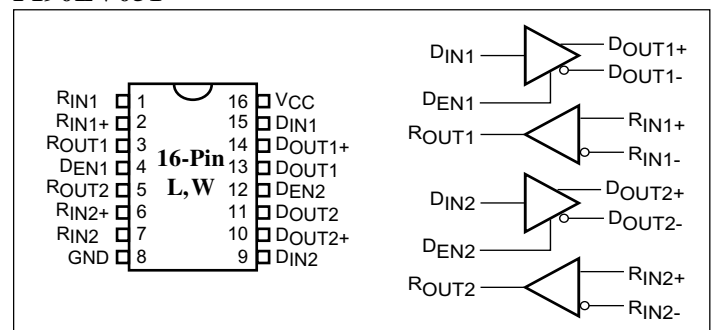
### PI90LV050



### 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 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         |

### PI90LV180/PI90LV050/PI90LV051 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$ |      | $2.4 -  V_{ID} /2$<br>$V_{CC} - 0.8$ |       |
| 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                                |      | 6                 | 9    | mA    |
|                                  | PI90LV180 | Driver and receiver enabled. No receiver load, Driver R <sub>L</sub> = 100 ohms   |      | 6                 | 9    |       |
|                                  |           | Driver disabled, Receiver disabled, R <sub>L</sub> = 100 ohms                     |      | 2.7               | 4    |       |
|                                  |           | Driver disabled, Receiver enabled, No load                                        |      | 1.6               | 2.1  |       |
|                                  |           | Disabled                                                                          |      | 1.5               | 2.5  |       |
|                                  | PI90LV050 | Driver and receivers enabled. No receiver loads, Driver R <sub>L</sub> = 100 ohms |      | 12                | 15   |       |
|                                  |           | Drivers disabled, Receivers disabled, R <sub>L</sub> = 100 ohms                   |      | 2.5               | 3    |       |
|                                  |           | Drivers disabled, Receivers enabled, No loads                                     |      | 1.0               | 1.2  |       |
|                                  |           | Disabled                                                                          |      | 1.3               | 1.6  |       |
|                                  | PI90LV051 | Drivers enabled, No receiver loads, Driver R <sub>L</sub> = 100 ohms              |      | 12.3              | 14.8 |       |
|                                  |           | Drivers disabled, No loads                                                        |      | 1.0               | 1.2  |       |

<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<br>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    |       |
| 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   | −8    | mA    |
|                      |                                                                        | V <sub>OD</sub> = 0V                    |                                                  |       | −8   | −10   |       |
| 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      |       |      |       |       |
| C <sub>IN</sub>      | Input capacitance                                                      |                                         |                                                  |       | 3    | 8.5   | pF    |

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

| Parameter    |                                                     | Test Conditions          | Min. | Typ. | Max.     | Units         |
|--------------|-----------------------------------------------------|--------------------------|------|------|----------|---------------|
| $V_{IH+}$    | Positive-going differential input voltage threshold | See Figures 5 & Table 1  |      |      | 50       | mV            |
| $V_{IH-}$    | Negative-going differential input voltage threshold |                          | -50  |      |          |               |
| $V_{OH}$     | High-level output voltage                           | $I_{OH} = -8\text{mA}$   | 2.4  |      |          | V             |
| $V_{OL}$     | Low-level output voltage                            | $I_{OL} = 8\text{mA}$    |      |      | 0.4      | V             |
| $I_I$        | Input current ( $R_{IN+}$ or $R_{IN-}$ )            | $V_I = 0$                | -2   | -11  | -20      | $\mu\text{A}$ |
|              |                                                     | $V_I = 2.4\text{V}$      | -1.2 | -3   |          |               |
| $I_{I(OFF)}$ | Power-off input current ( $R_{IN+}$ or $R_{IN-}$ )  | $V_{CC} = 0$             |      |      | $\pm 20$ |               |
| $I_{IH}$     | High-level input current (enables)                  | $V_{IH} = 2\text{V}$     |      |      | $\pm 10$ |               |
| $I_{IL}$     | Low-level input current (enables)                   | $V_{IL} = 0.8\text{V}$   |      |      | $\pm 10$ |               |
| $I_{OZ}$     | High-impedance output current                       | $V_O = 0$ or $5\text{V}$ |      |      | $\pm 10$ |               |
| $C_I$        | 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 |
|--------------|-------------------------------------------------------------|----------------------------------------------------------------|------|-------|------|-------|
| $t_{PLH}$    | Propagation delay time, low-to-high-level output            | $R_L = 100\text{ ohms}$<br>$C_L = 10\text{pF}$<br>See Figure 2 |      | 1.9   | 2.5  | ns    |
| $t_{PHL}$    | Propagation delay time, high-to-low-level output            |                                                                |      | 1.9   | 2.4  |       |
| $t_r$        | Differential output signal rise time                        |                                                                |      | 1     | 1.3  |       |
| $t_f$        | Differential output signal fall time                        |                                                                |      | 1     | 1.3  |       |
| $t_{sk(p)}$  | Pulse skew ( $t_{PHL} - t_{PLH}$ )                          |                                                                |      | 200   |      | ps    |
| $t_{sk(o)}$  | Channel-to-channel output skew‡                             |                                                                |      | 80    | 170  |       |
| $t_{sk(pp)}$ | Part-part skew**                                            |                                                                |      |       | 0.9  | ns    |
| $t_{PZH}$    | Propagation delay time, high-impedance-to-high-level output | See Figure 7                                                   |      | 3.4   | 5    |       |
| $t_{PZL}$    | Propagation delay time, high-impedance-to-low-level output  |                                                                |      | 2.5   | 5    |       |
| $t_{PHZ}$    | Propagation delay time, high-level-to-high-impedance output |                                                                |      | 3     | 5    |       |
| $t_{PLZ}$    | Propagation delay time, low-level-to-high-impedance output  |                                                                |      | 3.2   | 5    |       |

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

‡ $t_{sk(o)}$ : maximum delay time difference between drivers on the same device.

\*\* $t_{sk(pp)}$ : magnitude of difference in propagation delay times between any specific terminals of two devices (all things being equal).

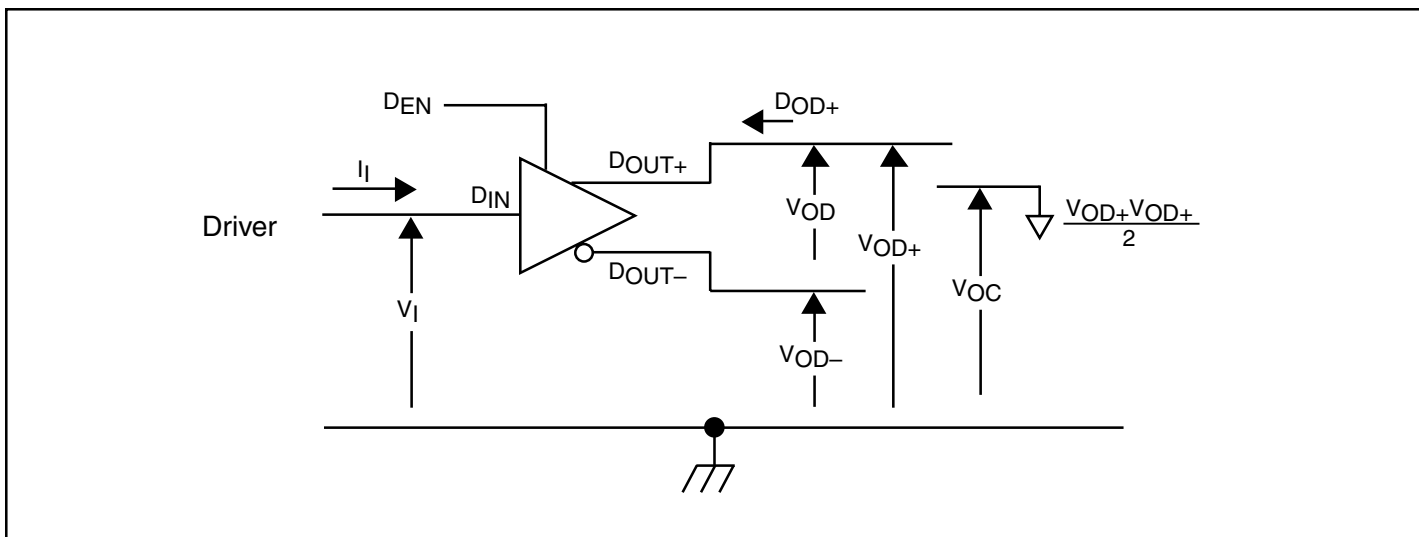
**Receiver Switching Characteristics** (over recommended operating conditions unless otherwise noted).

| 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<br>See Figure 6 |      | 1.9               | 2.9  | ns    |
| t <sub>PHL</sub>      | Propagation delay time, high-to-low-level output            |                                       |      | 2.1               | 3.1  |       |
| 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                                     |                                       |      | 50                | 100  | ps    |
| t <sub>r</sub>        | Output signal rise time                                     | See Figure 7                          |      | 1.2               | 1.7  | ns    |
| t <sub>f</sub>        | Output signal fall time                                     |                                       |      | 1.4               | 2.0  |       |
| t <sub>PZH</sub>      | Propagation delay time, high-level-to-high-impedance output |                                       |      | 1.5               | 2.7  |       |
| t <sub>PZL</sub>      | Propagation delay time, low-level-to-low-impedance output   |                                       |      | 4.5               | 6.8  |       |
| t <sub>PHZ</sub>      | Propagation delay time, high-impedance-to-high-level output |                                       |      | 2.4               | 3.1  |       |
| 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

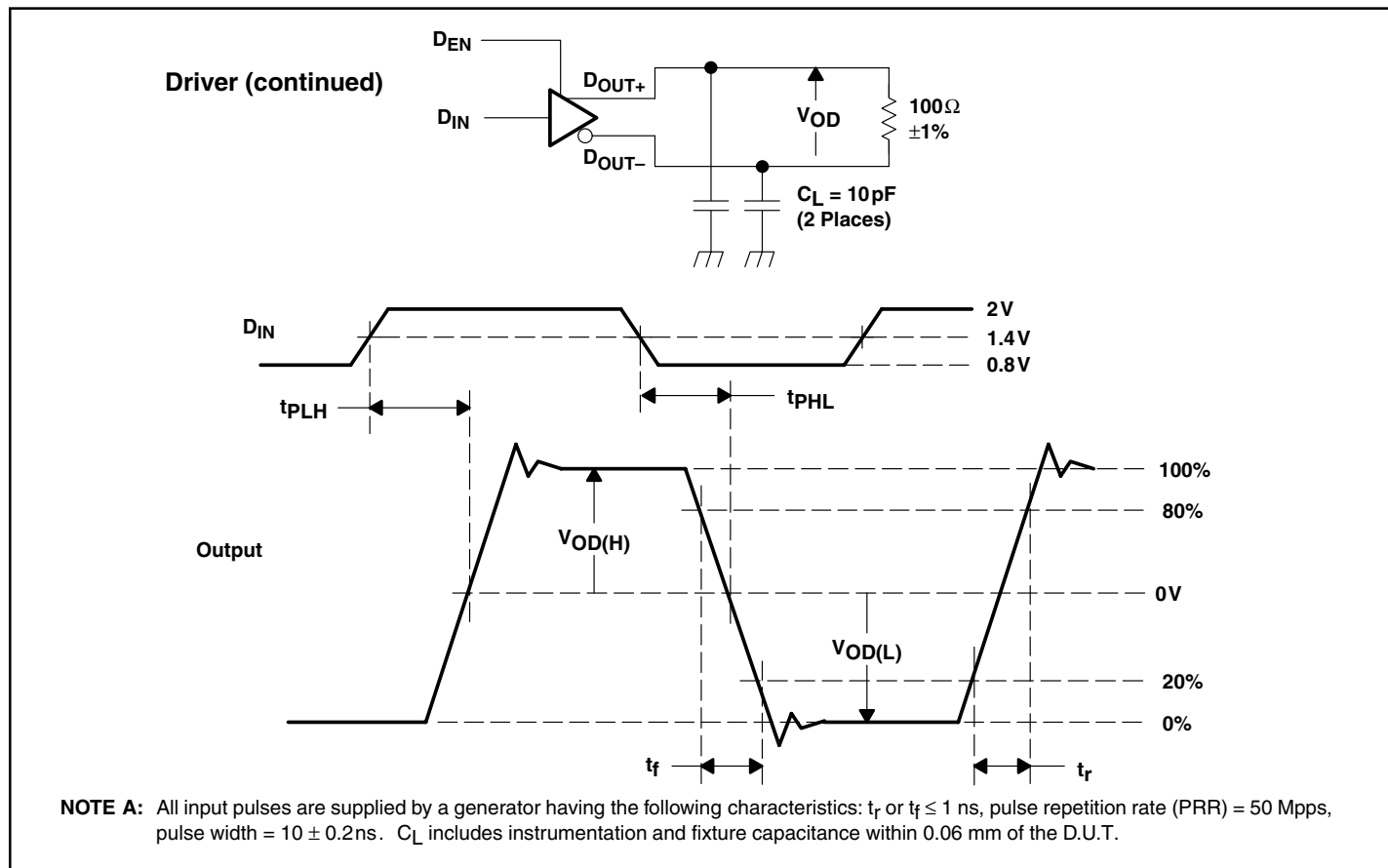
\*\*t<sub>sk(pp)</sub>: magnitude of difference in propagation delay times between any specific terminals of two devices (all things being equal)

**Parameter Measurement Information**

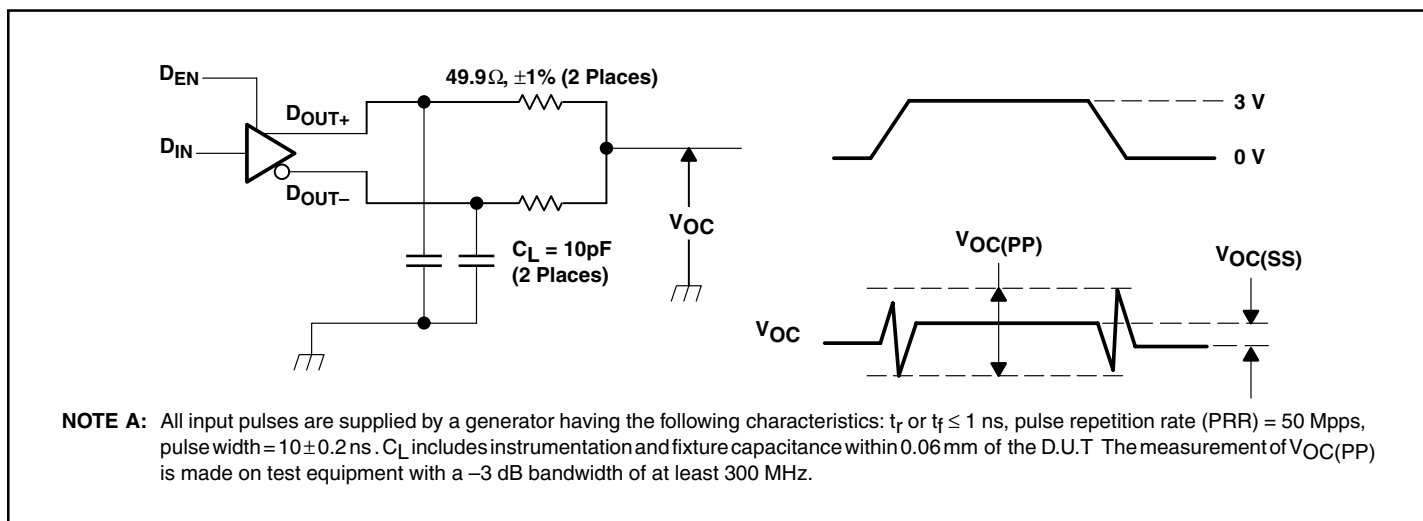


**Figure 1. Driver Voltage and Current Definitions**

## Parameter Measurement Information

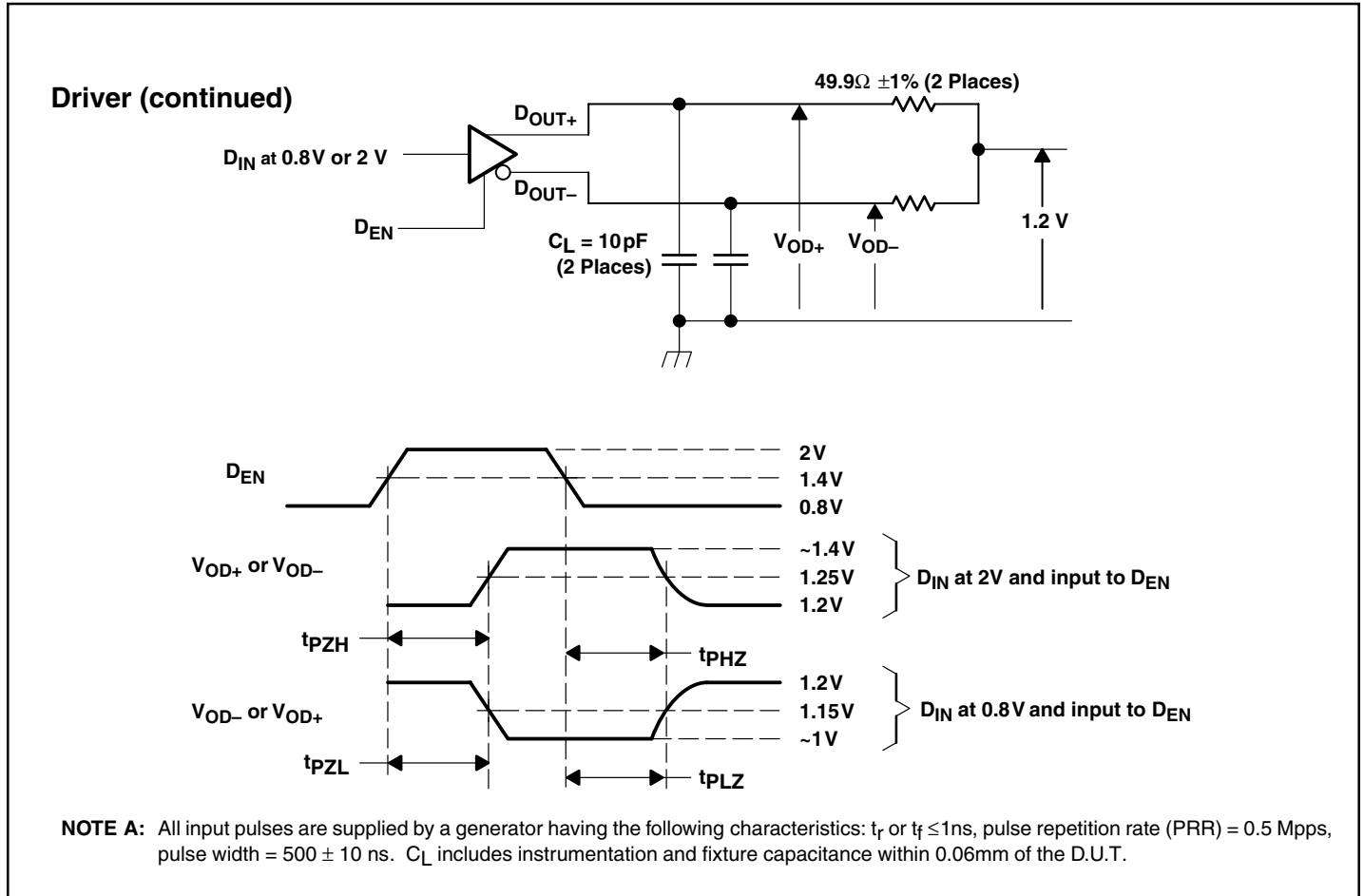


**Figure 2. Test Circuit, Timing, and Voltage Definitions for the Differential Output Signal**



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

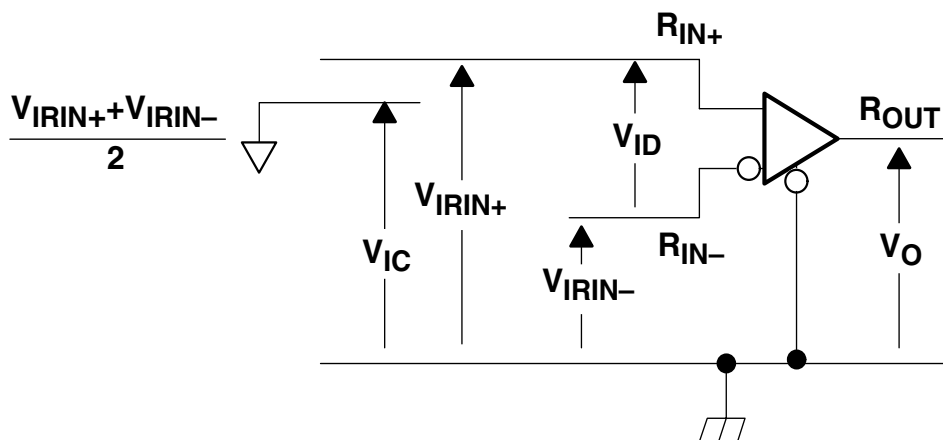
## Parameter Measurement Information



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

## Parameter Measurement Information

### Receiver



**Figure 5. Receiver Voltage Definitions**

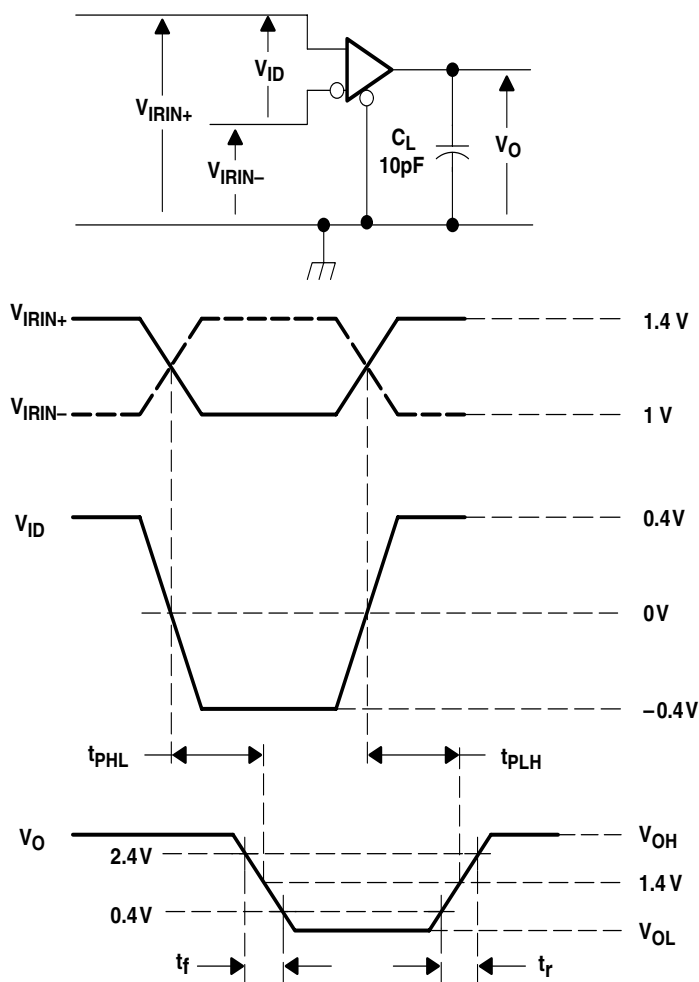
**Table 1. Receiver Minimum and Maximum Input Threshold Test Voltages**

| APPLIED VOLTAGES<br>(V) |             | RESULTING DIFFERENTIAL<br>INPUT VOLTAGE<br>(mV) | RESULTING COMMON-<br>MODE INPUT VOLTAGE<br>(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

### PARAMETER MEASUREMENT INFORMATION

#### Receiver (continued)



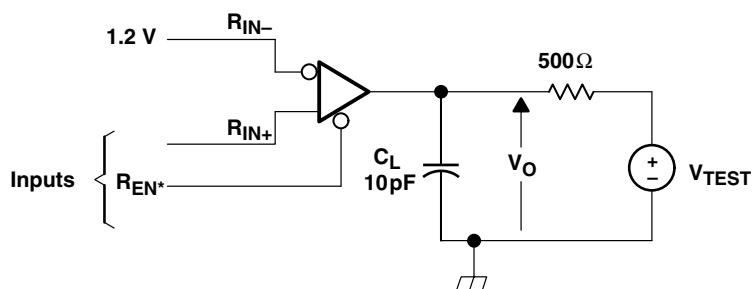
**NOTE A:** All input pulses are supplied by a generator having the following characteristics:  $t_f$  or  $t_r \leq 1\text{ ns}$ , pulse repetition rate (PRR) = 50 Mpps, pulse width =  $10 \pm 0.2\text{ ns}$ .  $C_L$  includes instrumentation and fixture capacitance within 0.06 m of the D.U.T.

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

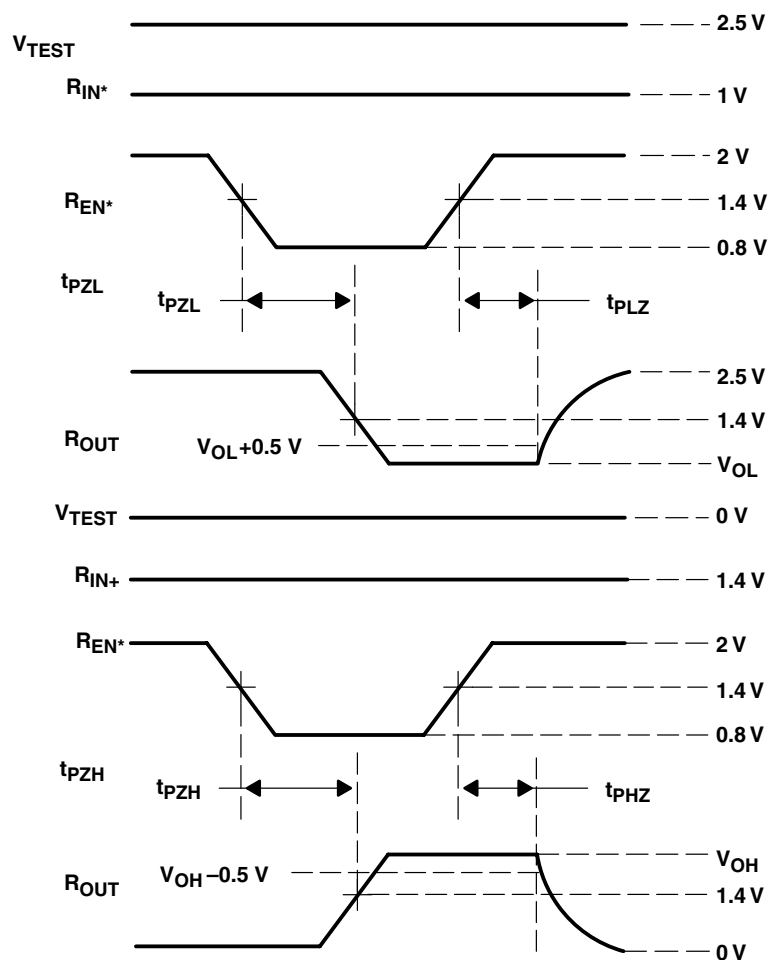
**Figure 6. Timing Test Circuit and Waveforms**

## Parameter Measurement Information

### Receiver (continued)

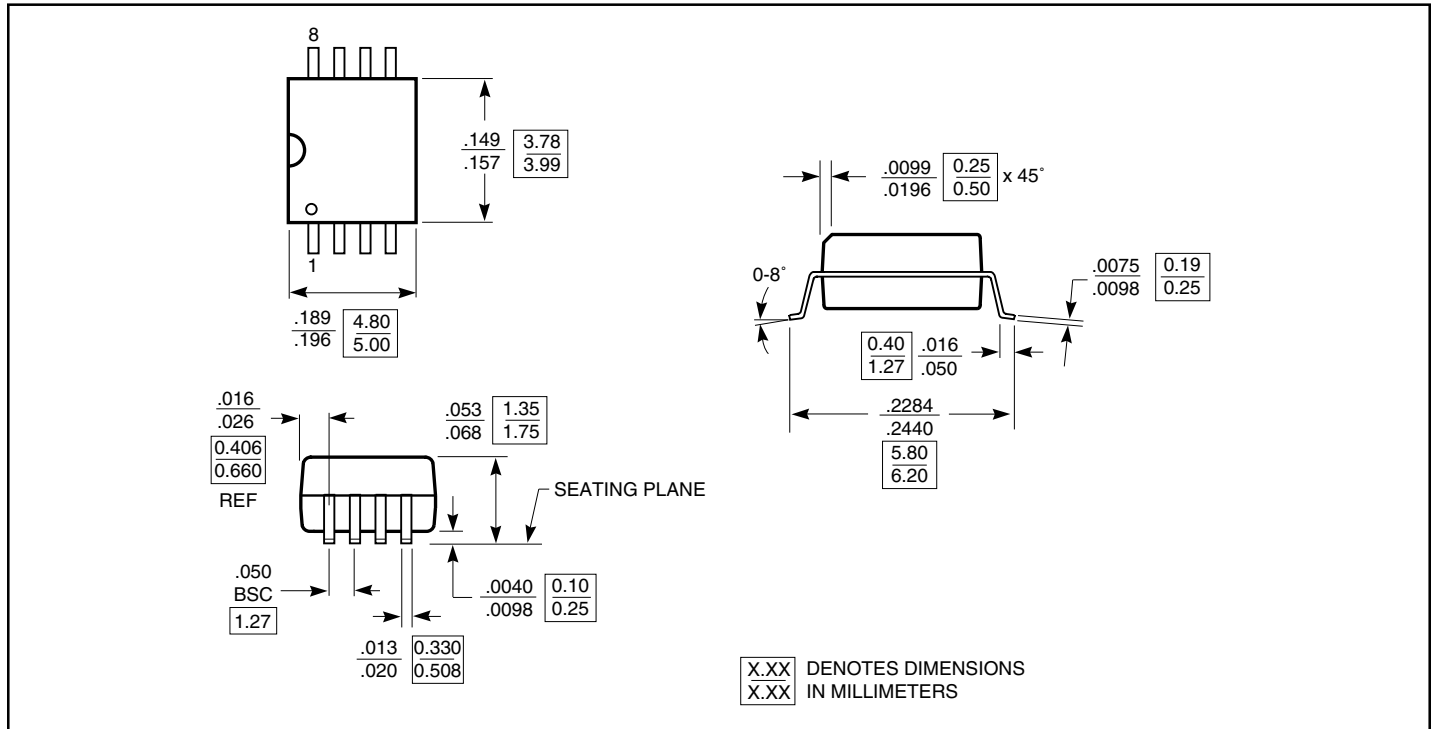


**NOTE A:** All input pulses are supplied by a generator having the following characteristics:  $t_r$  or  $t_f \leq 1\text{ns}$ , pulse repetition rate (PRR) = 0.5 Mpps, pulse wide =  $500 \pm 10\text{ns}$ .  $C_L$  includes instrumentation and fixture capacitance within 0.06m of the D.U.T.

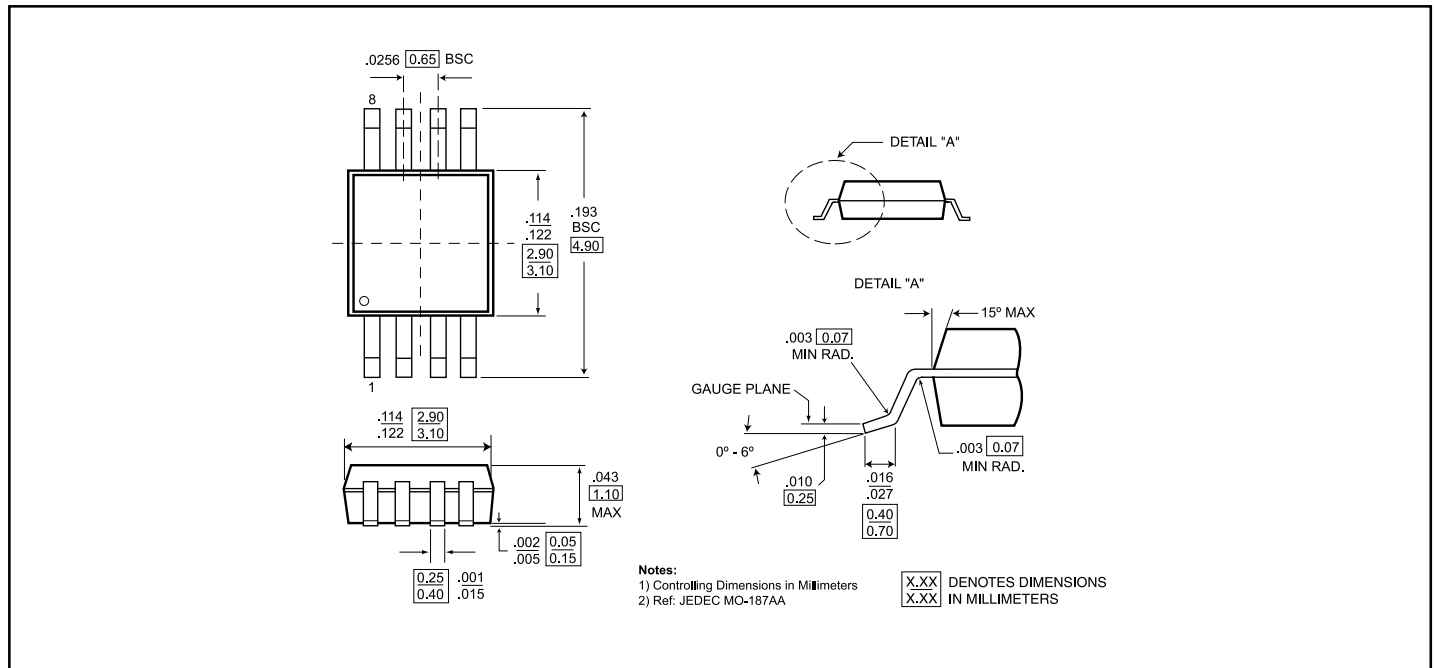


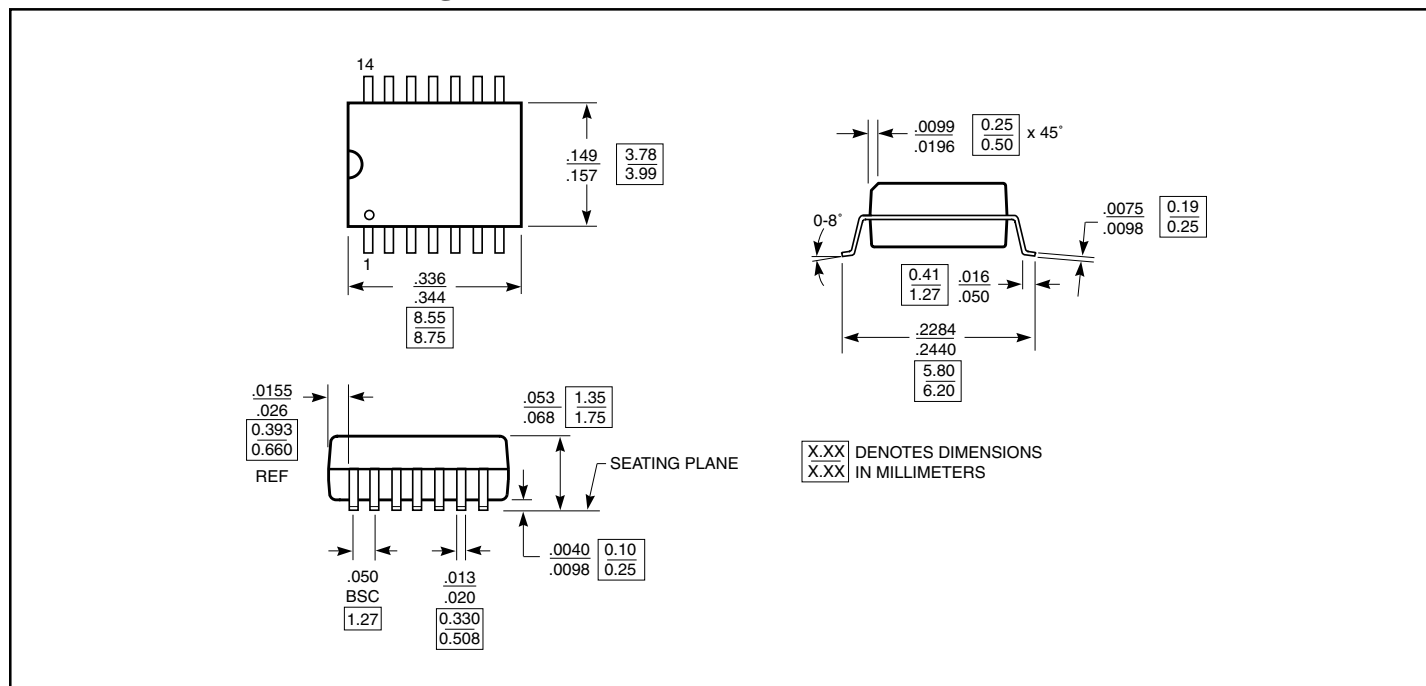
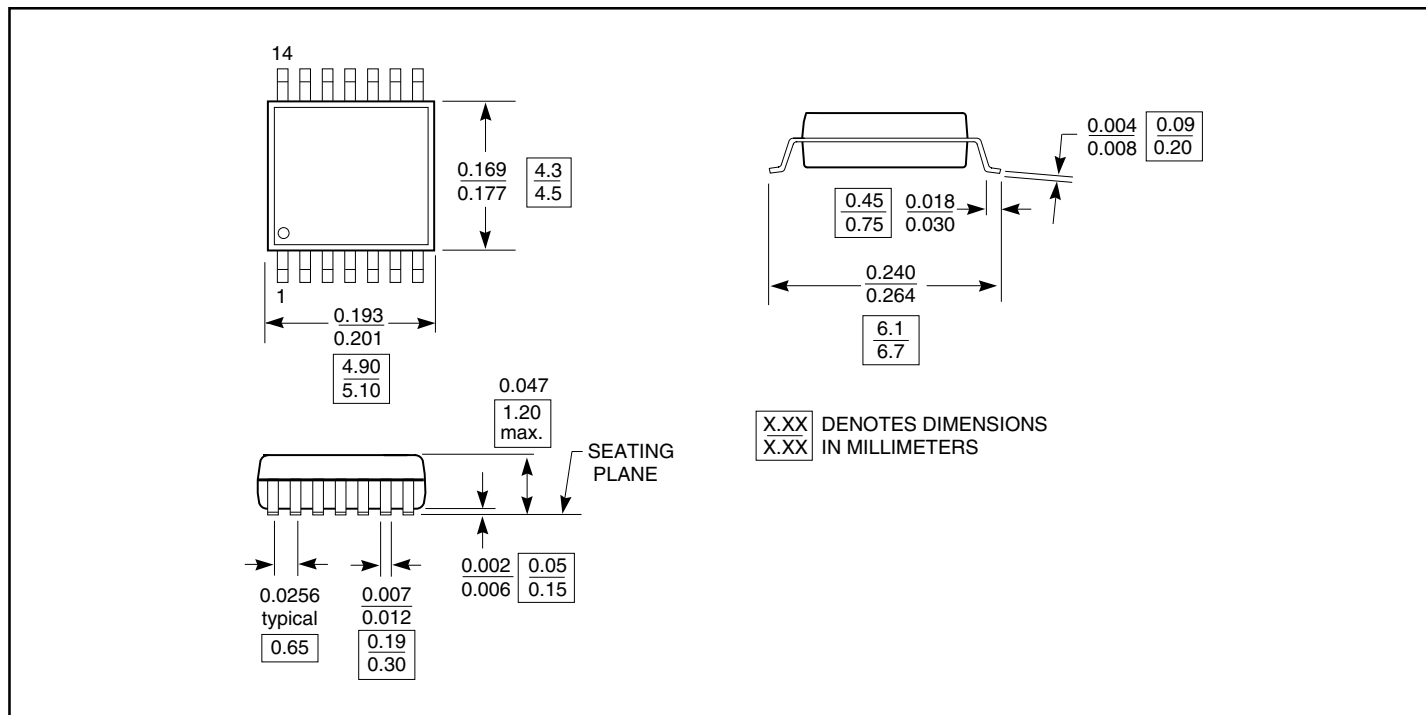
**Figure 7. Enable/Disable Time Test Circuit and Waveforms**

## 8-Pin SOIC W Package

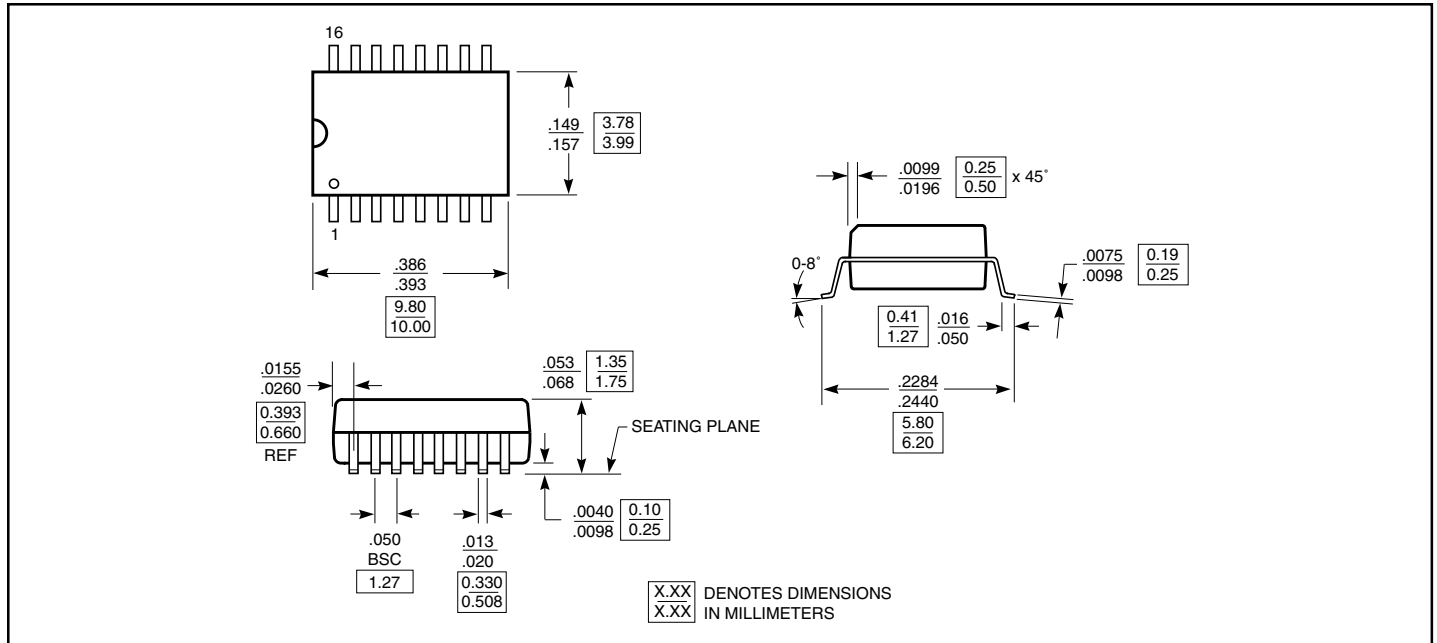


## 8-Pin Mini Small Outline U Package (MSOP)

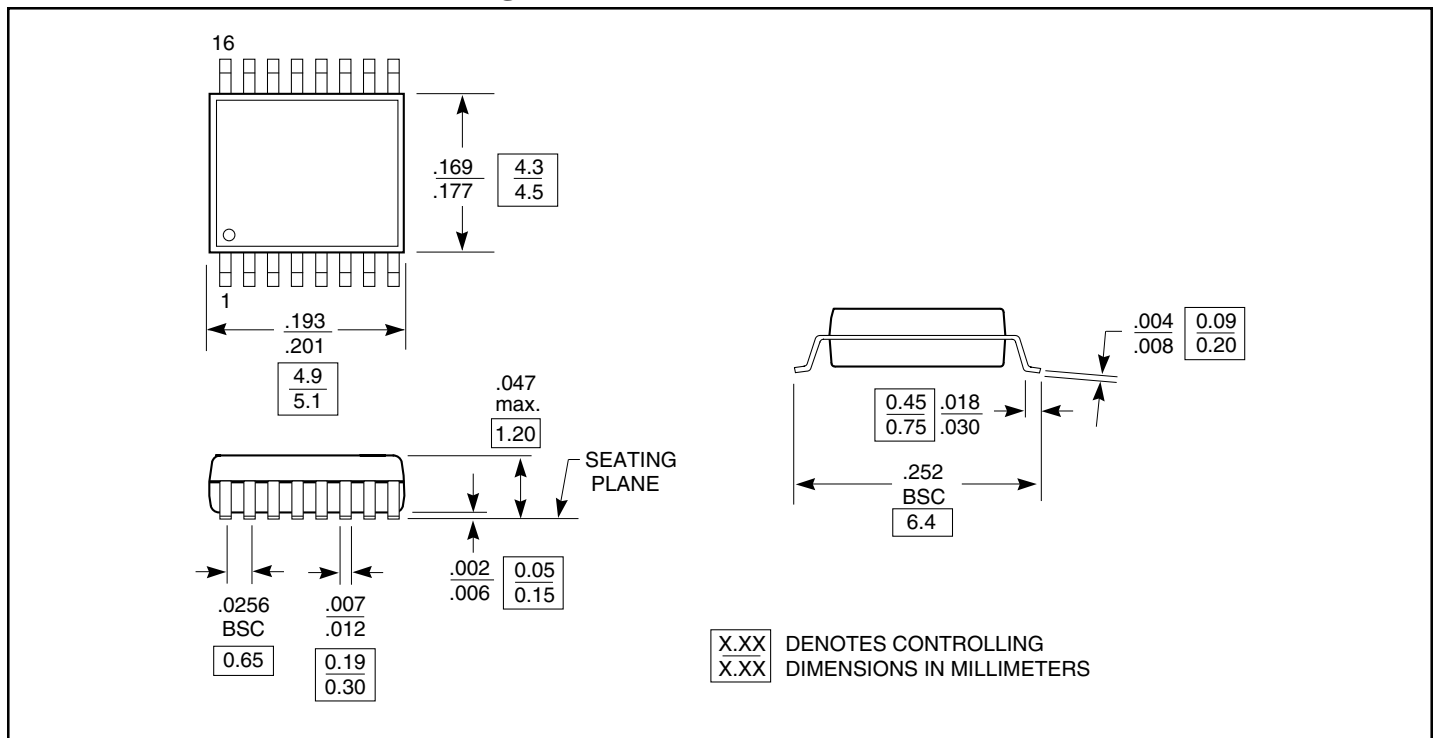


**14-Pin SOIC (150 Mil) W Package**

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


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



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





**PI90LV179/PI90LV180/  
PI90LV050/PI90LV051**  
**3.3V LVDS High-Speed Differential Line Drivers and Receivers**

**Ordering Information**

| <b>Part</b> | <b>Pin - Package</b> | <b>Temperature</b> |
|-------------|----------------------|--------------------|
| PI90LV179W  | 8-SOIC               | -40°C to +85°C     |
| PI90LV180W  | 14-SOIC              | -40°C to +85°C     |
| PI90LV050W  | 16-SOIC              | -40°C to +85°C     |
| PI90LV051W  | 16-SOIC              | -40°C to +85°C     |
| PI90LV179U  | 8-MSOP               | -40°C to +85°C     |
| PI90LV180L  | 14-TSSOP             | -40°C to +85°C     |
| PI90LV050L  | 16-TSSOP             | -40°C to +85°C     |
| PI90LV051L  | 16-TSSOP             | -40°C to +85°C     |

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