

### Features

- Meets and Exceeds the Requirements of ANSI TIA/EIA-644-1995
- Designed for clocking rates up to 320MHz
- Operates from a single 3.3V Supply
- Low Voltage Differential Signaling (LVDS) with Output Voltages of  $\pm 350\text{mV}$  into a  $100\Omega$  load
- Choice between LVDS or TTL clock input
- Synchronous Enable/Disable
- Clock outputs default LOW when inputs open
- Multiplexed clock input
  - Internal  $300\text{k}\Omega$  pullup resistor on input pins
  - CLK and  $\overline{\text{CLK}}$  have  $110\Omega$  internal termination (PI90LVT14)
- 50ps Output-to-Output Skew
- 475ps typical propagation delay
- Bus Pins are high impedance when disabled or with  $V_{CC}$  less than 1.5V
- TTL inputs are 5V Tolerant
- Power Dissipation at 400Mbps/s of 150mW
- Function compatible to Motorola (PECL) MC100EL14 and Micrel/Synergy (PECL) SY100EL14V
- >9kV ESD Protection
- 20-pin TSSOP (L) and QSOP (Q) packages

### Pin Descriptions

| Pin                          | Function                   |
|------------------------------|----------------------------|
| CLK, $\overline{\text{CLK}}$ | Differential Clock Outputs |
| SCLK                         | LVTTTL Clock Input         |
| $\overline{\text{EN}}$       | Synchronous Enable         |
| SEL                          | Clock Select Input         |
| CLK1-5OUT $\pm$              | Differential Clock Inputs  |

### Function Table

| CLK          | SCLK         | SEL | $\overline{\text{EN}}^*$ | CLKOUT+ |
|--------------|--------------|-----|--------------------------|---------|
| L            | X            | L   | L                        | L       |
| H            | X            | L   | L                        | H       |
| X            | L            | H   | L                        | L       |
| X            | H            | H   | L                        | H       |
| $\downarrow$ | $\downarrow$ | X   | H                        | Z*      |

\* On next negative transition of CLK, or SCLK

### Description

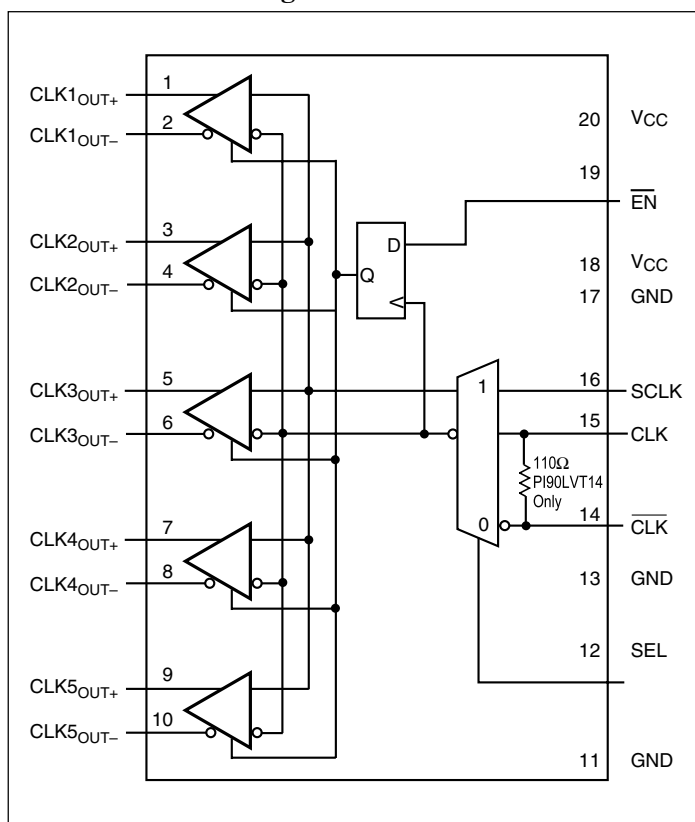
The PI90LV14 implements low voltage differential signaling (LVDS) to achieve clocking rates as high as 320MHz with low skew.

The PI90LV14 is a low-skew 1:5 clock distribution chip which incorporates multiplexed clock inputs to allow for distribution of a lower-speed, single-ended clock or a high-speed system clock. When LOW the SEL pin will select the differential clock input.

The common enable ( $\overline{\text{EN}}$ ) is synchronous so that the outputs will only be enabled/disabled when they are already in the LOW state. This avoids any chance of generating a runt clock pulse when the device is enabled/disabled as can happen with an asynchronous control. Because the internal flip-flop is clocked on the falling edge of the input clock, all associated specification limits are referenced to the negative edge of the clock input.

The intended application of these devices and signaling technique is for high-speed clock distribution between boards.

### PI90LV14 Block Diagram



**Electrical Characteristics over Recommended Operating Conditions** (unless otherwise noted).

| Symbol              | Parameter                                                              | Test Conditions                                     | Min.  | Typ. <sup>(1)</sup> | Max.      | Units    |
|---------------------|------------------------------------------------------------------------|-----------------------------------------------------|-------|---------------------|-----------|----------|
| $ V_{OD} $          | Differential output voltage magnitude                                  | $R_L = 100\Omega$<br>See Figures 1 and 2            | 247   | 340                 | 454       | mV       |
| $\Delta V_{OD} $    | Change in differential output voltage magnitude between logic states   |                                                     | -50   |                     | 50        |          |
| $V_{OC(SS)}$        | Steady-state common-mode output voltage                                | See Figure 3                                        | 1.125 | 1.40                | 1.7       | V        |
| $\Delta V_{OC(SS)}$ | Change in steady-state common-mode output voltage between logic states |                                                     | -50   |                     | 50        | mV       |
| $V_{OC(PP)}$        | Peak-to-peak common-mode output voltage                                |                                                     |       | 60                  | 100       |          |
| $I_{CC}$            | Supply Current                                                         | Enabled, $R_L = 100\Omega$ $V_{IN} = V_{CC}$ or GND |       | 21                  | 35        | mA       |
|                     |                                                                        | Disabled, $V_{IN} = V_{CC}$ or GND                  | 0.5   | 2.5                 | 4.0       |          |
| $I_{IH}$            | High-level input current                                               | $V_{IH} = 2V$                                       |       | 3.0                 | 20        | $\mu A$  |
| $I_{IL}$            | Low-level input current                                                | $V_{IL} = 0.8V$                                     |       | 5.0                 | 20        |          |
| $I_{OS}$            | Short-circuit output current                                           | $V_{ODOUT+}$ or $V_{ODOUT-} = 0V$                   |       |                     | $\pm 7.4$ | mA       |
|                     |                                                                        | $V_{OD} = 0V$                                       |       |                     | $\pm 4.7$ |          |
| $I_{OZ}$            | High-impedance output current                                          | $V_O = 0V$ or $V_{CC}$                              |       |                     | 1         | $\mu A$  |
| $I_{O(OFF)}$        | Power-off output current                                               | $V_{CC} = 1.5V$ , $V_O = 2.4V$                      |       |                     | 1         |          |
| $C_{IN}$            | Input capacitance,                                                     | $V_I = 0.4 \sin(4E6\pi t) + 0.5V$                   |       | 9                   |           | pF       |
| $C_O$               | Output capacitance                                                     | $V_I = 0.4 \sin(4E6\pi t) + 0.5V$ , Disabled        |       | 10                  |           |          |
| $R_{TERM}$          | Termination Resistor                                                   | PI90LVT14                                           | 90    | 110                 | 132       | $\Omega$ |

**Switching Characteristics over Recommended Operating Conditions** (unless otherwise noted)<sup>(8,9)</sup>.

| Characteristic                                                                          | Symbol                                                                       | Min.       | Typ.                     | Max.                     | Units | Condition |
|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------|--------------------------|--------------------------|-------|-----------|
| Propagation Delay to Output<br>CLK to CLKOUT ±<br>SCLK to CLKOUT ±<br>SEL to CLKOUT ±   | t <sub>PLH</sub><br>t <sub>PHL</sub>                                         |            | 3.0<br>2.5<br>2.6        | 4.0<br>3.5<br>3.6        | ns    |           |
| Disable Time<br>CLK or SCLK to CLKOUT ±                                                 | t <sub>PHZ</sub><br>t <sub>PLZ</sub><br>t <sub>PZH</sub><br>t <sub>PZL</sub> |            | 2.7<br>2.7<br>4.7<br>3.7 | 3.5<br>3.5<br>6.0<br>6.0 | ns    | 2         |
| Part-to-Part Skew<br>CLK (Diff) to Q<br>CLK (SE), SCLK to Q<br>With Device Skew         | t <sub>skew</sub><br>t <sub>skew</sub><br>t <sub>skew</sub>                  |            |                          | TBD<br>TBD<br>TBD        | ps    | 1         |
| Setup Time<br>EN <sub>x</sub> to CLK<br>CEN to CLK                                      | t <sub>s</sub><br>t <sub>s</sub>                                             | 100<br>100 | -100<br>-100             |                          |       | 2         |
| Hold Time<br>EN <sub>x</sub> , CEN to SCLK<br>EN <sub>x</sub> , CEN to CLK <sub>x</sub> | t <sub>h</sub><br>t <sub>h</sub>                                             |            | 550<br>500               | 720<br>720               |       | 2         |
| <b>Minimum Input Swing (CLK)</b>                                                        | V <sub>PP</sub>                                                              | 0.20       |                          | 0.800                    | V     | 3         |
| <b>Com. Mode Range (CLK)</b>                                                            | V <sub>CMR</sub>                                                             | 0.125      | 1.5                      | V <sub>CC</sub> - 0.20   |       | 4         |
| <b>Rise/Fall Times (20 – 80%)</b><br>SCLK to CLKOUT±<br>SCLK to CLKOUT±                 | t <sub>r</sub><br>t <sub>f</sub>                                             | 150<br>150 |                          | 1200<br>1200             | ps    |           |
| <b>Duty Cycle Distortion Pulse Skew ( t<sub>PLH</sub> - t<sub>PHL</sub> )</b>           | t <sub>SK1R</sub>                                                            |            | 200                      | 300                      |       | 5         |
| <b>Channel-to-Channel Skew, same edge</b>                                               | t <sub>SK2R</sub>                                                            |            | 70                       | 190                      |       | 6         |
| <b>Maximum Operating Frequency</b>                                                      |                                                                              |            | 250                      |                          | MHz   | 7         |

**Notes:**

1. Within-Device skew is defined for identical transitions on similar paths through a device.
2. Setup, Hold, and Disable times are all relative to a falling edge on CLK or SCLK.
3. Minimum input swing for which AC parameters are guaranteed. Full DC LVDS output swings will be generated with only 50mV input swings.
4. The range in which the high level of the input swing must fall while meeting the V<sub>PP</sub> spec.
5. t<sub>SK1R</sub> is the difference in receiver propagation delay (t<sub>PLH</sub>-t<sub>PHL</sub>) of one device, and is the duty cycle distortion of the output at any given temperature and V<sub>CC</sub>. The propagation delay specification is a device-to-device worst case over process, voltage, and temperature.
6. t<sub>SK2R</sub> is the difference in receiver propagation delay between channels in the same device of any outputs switching in the same direction. This parameter is guaranteed by design and characterization.
7. Generator input conditions: t<sub>r</sub>t<sub>f</sub> < 1ns, 50% duty cycle, differential (1.10V to 1.35V peak-peak).  
Output Criteria: 60%/40% duty cycle, V<sub>OL</sub>(max) 0-4V, V<sub>OH</sub>(min) 2.7V, Load - 7pF (stray plus probes).
8. C<sub>L</sub> includes probe and fixture capacitance.
9. Generator waveform for all tests unless otherwise specified: f = 25 MHz, Z<sub>0</sub> = 50Ω, t<sub>r</sub> = 1ns, t<sub>f</sub> = 1ns (35%-65%). To ensure fastest propagation delay and minimum skew, clock input edge rates should not be slower than 1ns/V; control signals not slower than 3ns/V.

## Parameter Measurement Information

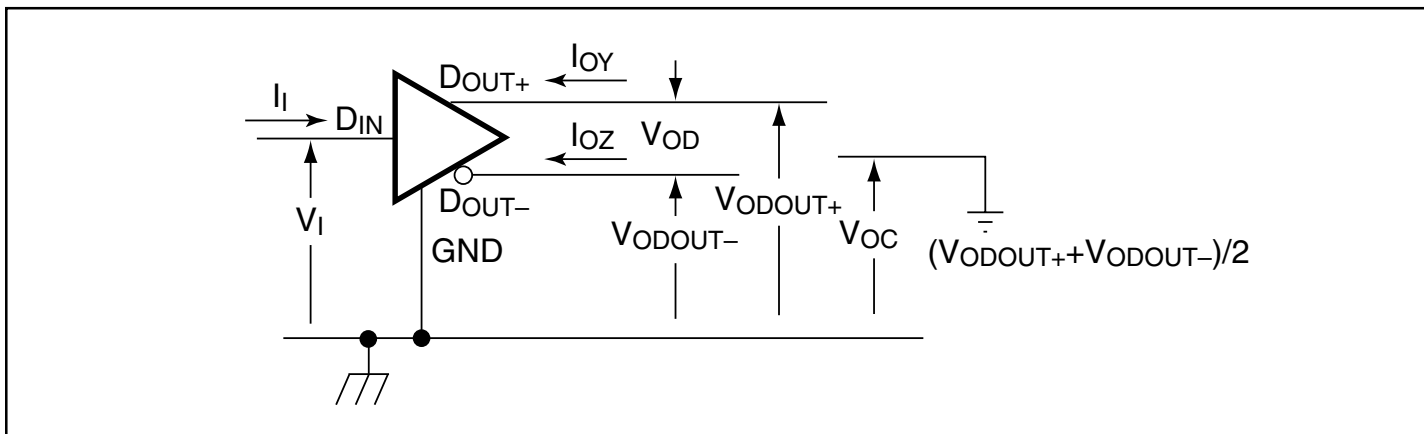


**Figure 1. Voltage and Current Definitions**

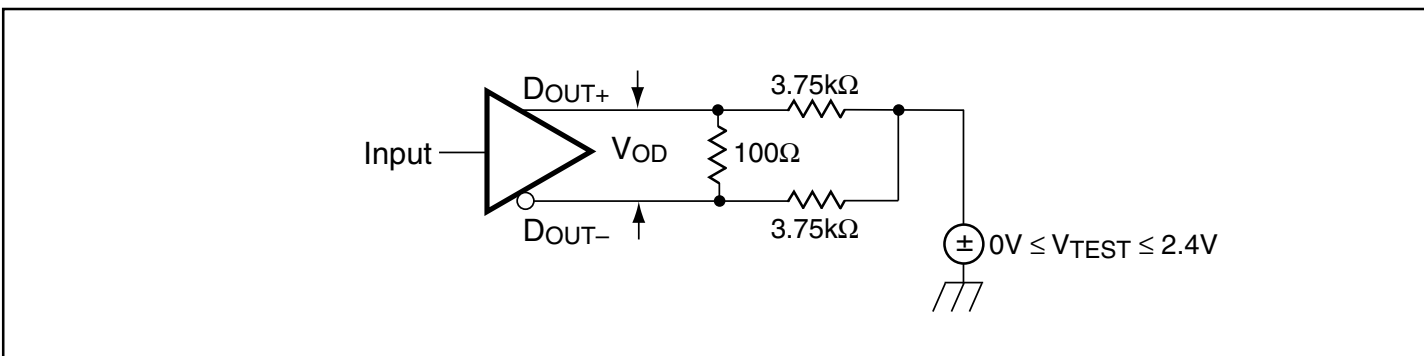


**Figure 2.  $V_{OD}$  Test Circuit**

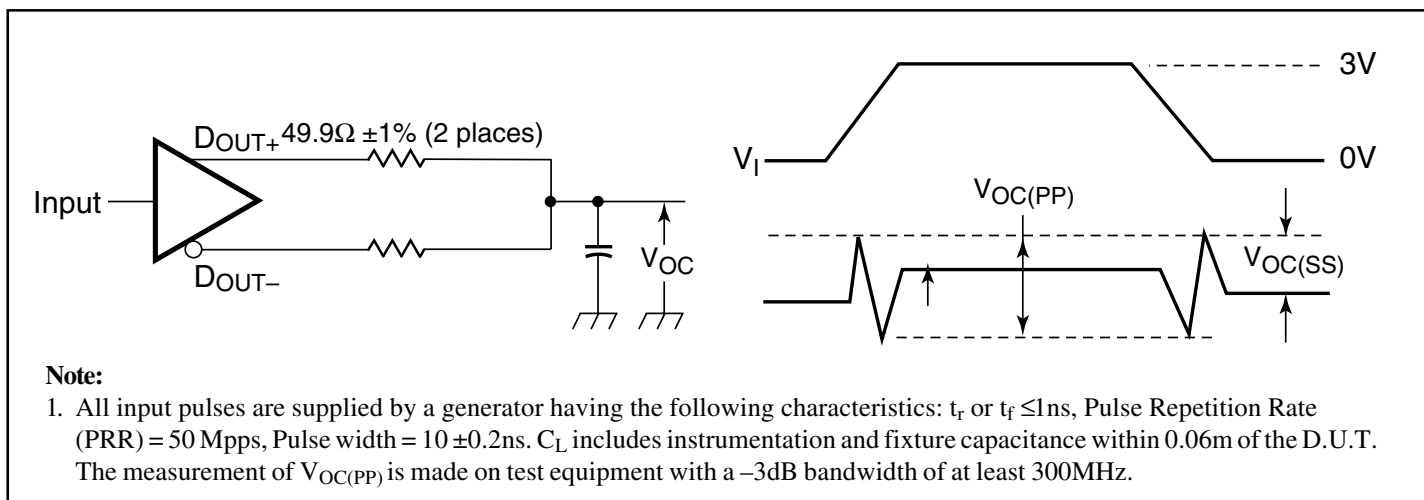
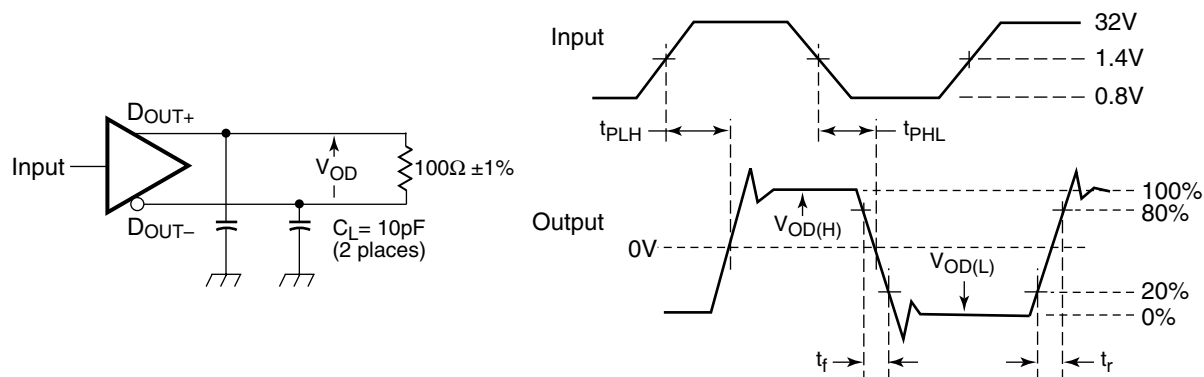
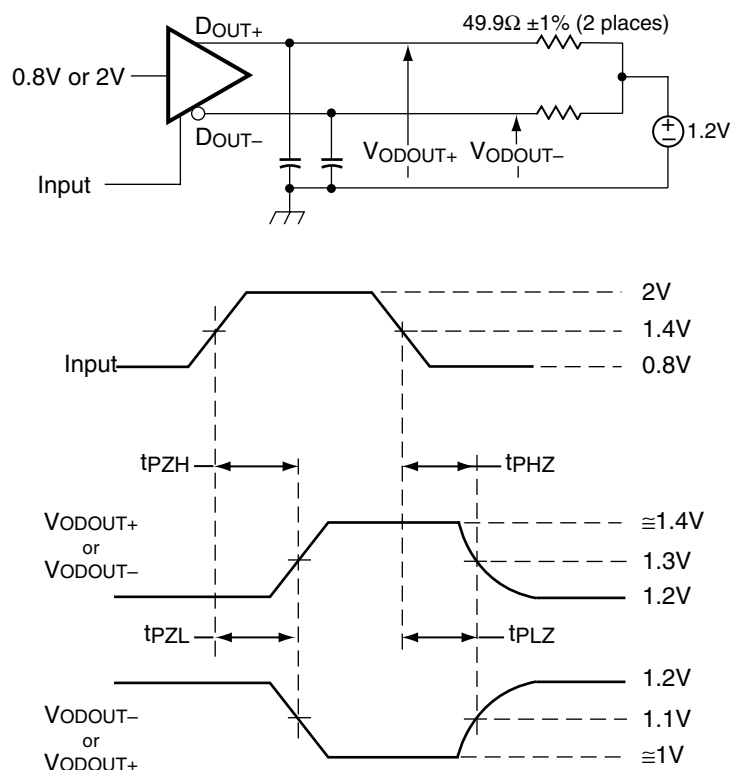


**Figure 3. Test Circuit & Definitions for the Driver Common-Mode Output Voltage**

**Parameter Measurement Information (continued)**

**Note:**

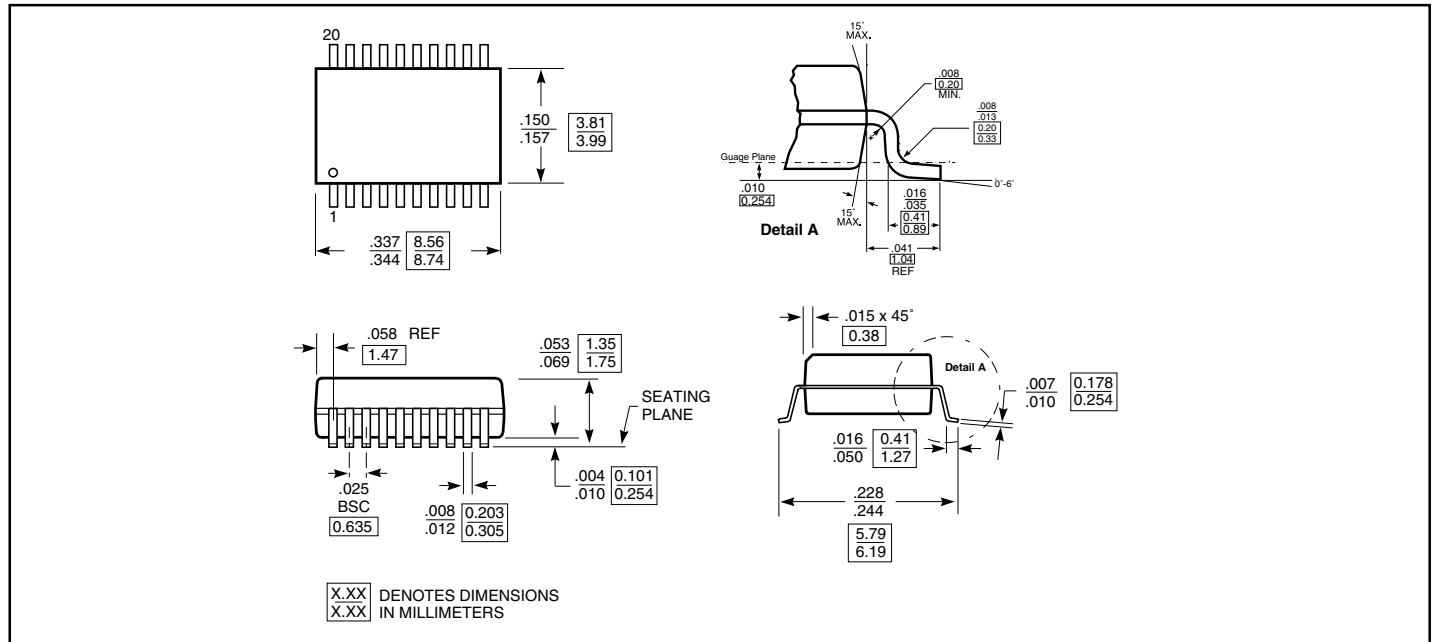
1. All input pulses are supplied by a generator having the following characteristics:  $t_r$  or  $t_f \leq 1\text{ns}$ , Pulse Repetition Rate (PRR) = 15 Mpps, Pulse width =  $10 \pm 0.2\text{ns}$ .  $C_L$  includes instrumentation and fixture capacitance within 0.06m of the D.U.T.

**Figure 4. Test Circuit, Timing, & Voltage Definitions for the Differential Output Signal**

**Note:**

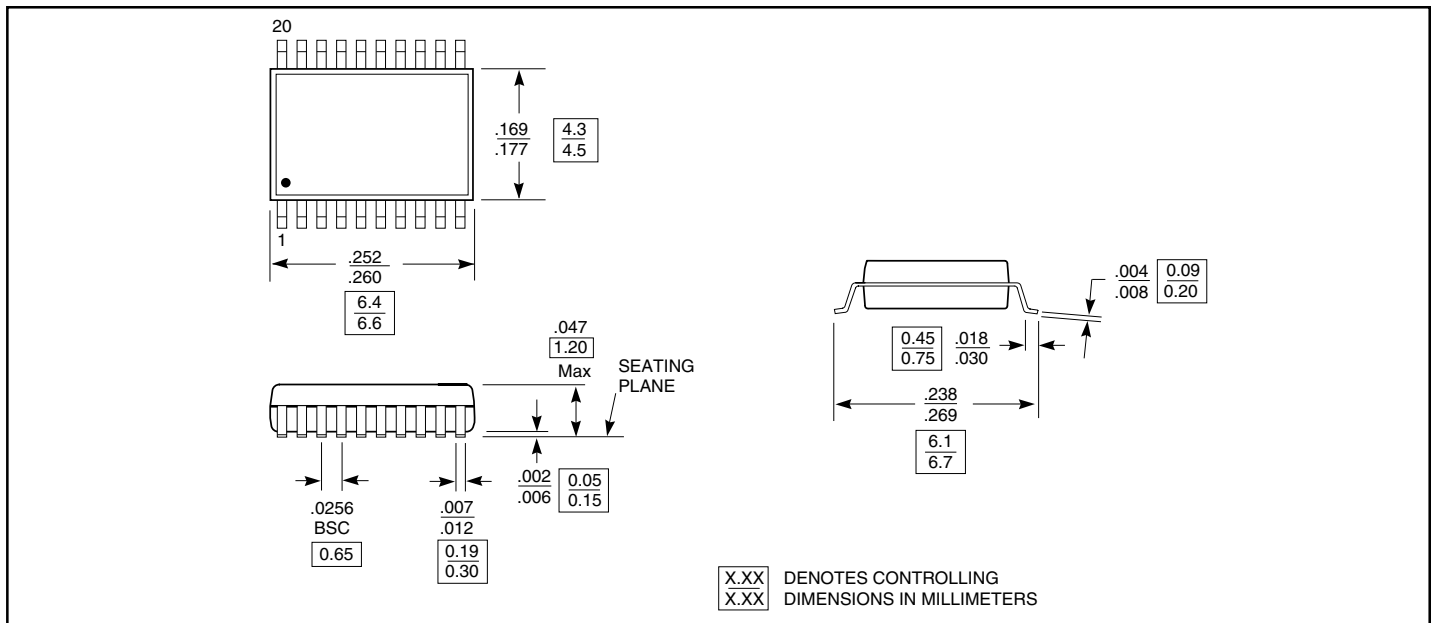
1. All input pulses are supplied by a generator having the following characteristics:  $t_r$  or  $t_f \leq 1\text{ns}$ , Pulse Repetition Rate (PRR) = 0.5 Mpps, Pulse width =  $500 \pm 10\text{ns}$ .  $C_L$  includes instrumentation and fixture capacitance within 0.06m of the D.U.T.

**Figure 5. Enable & Disable Time Circuit & Definitions**

## 20-Pin QSOP (Q) Package



## 20-Pin TSSOP (L) Package



## Ordering Information

| Ordering Code | Package Type         | Ordering Range |
|---------------|----------------------|----------------|
| PI90LV14L     | 20-Pin 173-mil TSSOP | −40°C to 85°C  |
| PI90LVT14L    |                      |                |
| PI90LV14Q     | 20-Pin 150-mil QSOP  |                |
| PI90LVT14Q    |                      |                |

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