

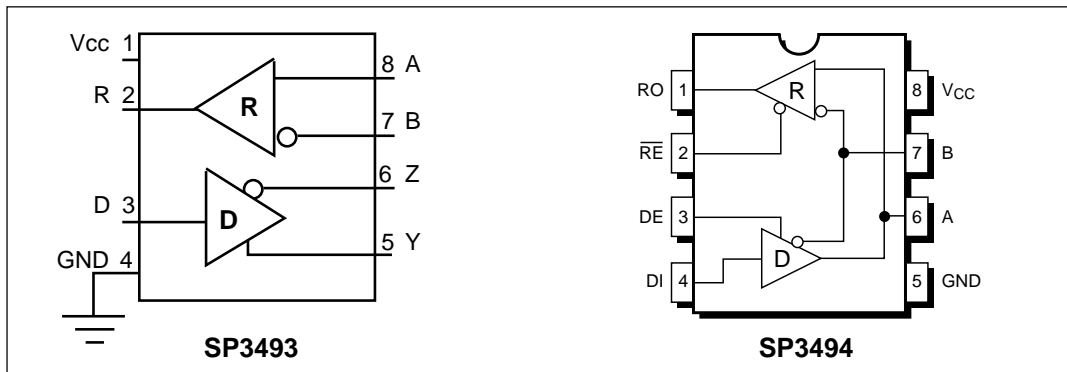
+3.3V Low Power Slew Rate Limited RS-485/RS-422 Transceivers

- Operates From A Single +3.3V Supply
- Interoperable With +5V Logic
- $\pm 200\text{mV}$ Receiver Input Sensitivity
- Slew-Rate Limited For Errorless Data Transmission to 250Kbps
- -7V to +12V Common-Mode Input Voltage Range
- Devices Allow Up To 32 Transceivers On The Serial Bus
- Driver/Receiver Enable Lines (**SP3494**)
- 2nA Low-Power Shutdown Mode (**SP3494**)
- Compatible With The MAX3488, LTC490 and 75179 Industry Standard Pinouts (**SP3493**)
- Compatible With The MAX3486 and 75176 Industry Standard Pinouts (**SP3494**)



DESCRIPTION

The **SP3493** and the **3494** devices are +3.3V, slew-rate limited transceivers that meet the specifications of the RS-485 and RS-422 serial protocols. The **SP3493** and the **3494** devices are pin-to-pin compatible with the **Sipex SP3490** and the **SP3481** devices, respectively, as well as other popular industry standards. The devices feature **Sipex's** BiCMOS process, allowing low power operation without sacrificing performance. The slew-rate limited drivers minimize EMI and reduce reflections caused by improperly terminated cables allowing error-free data transmission. The **SP3493** is a full-duplex slew-rate limited transceiver that will deliver a data transmission rate up to 250kbps. The **SP3494** is a half-duplex slew-rate limited transceiver that will deliver a data transmission rate up to 2.5Mbps. The **SP3494** is equipped with a low-power shutdown mode and driver/receiver high-Z enable lines.



ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

| | |
|---|----------------------------|
| V_{CC} | +7V |
| Input Voltages | |
| Drivers..... | -0.5V to ($V_{CC}+0.5V$) |
| Receivers..... | $\pm 14V$ |
| Output Voltages | |
| Drivers..... | $\pm 14V$ |
| Receivers..... | -0.5V to ($V_{CC}+0.5V$) |
| Storage Temperature..... | -65°C to +150° |
| Power Dissipation per Package | |
| 8-pin PDIP (derate 11.8mW/°C above +70°C)..... | 1000mW |
| 8-pin NSOIC (derate 6.90mW/°C above +70°C)..... | 600mW |



CAUTION:
ESD (ElectroStatic Discharge) sensitive device. Permanent damage may occur on unconnected devices subject to high energy electrostatic fields. Unused devices must be stored in conductive foam or shunts. Personnel should be properly grounded prior to handling this device. The protective foam should be discharged to the destination socket before devices are removed.

SPECIFICATIONS

$T_{AMB} = T_{MIN}$ to T_{MAX} and $V_{CC} = 3.3V \pm 5\%$ unless otherwise noted.

| PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|---|--------------|------|-----------|------------|---|
| SP3493 DRIVER | | | | | |
| DC Characteristics | | | | | |
| Differential Output Voltage | GND | | V_{CC} | Volts | Unloaded; $R = \infty \Omega$; <i>Figure 1</i> |
| Differential Output Voltage | 2 | | V_{CC} | Volts | With Load; $R = 50\Omega$; (RS-422); <i>Figure 1</i> |
| Differential Output Voltage Change in Magnitude of Driver | 1.5 | | V_{CC} | Volts | With Load; $R = 27\Omega$; (RS-485); <i>Figure 1</i> |
| Differential Output Voltage for Complimentary States | | | 0.2 | Volts | $R = 27\Omega$ or $R = 50\Omega$; <i>Figure 1</i> |
| Driver Common-Mode Output Voltage | | | 3 | Volts | $R = 27\Omega$ or $R = 50\Omega$; <i>Figure 1</i> |
| Input High Voltage | 2.0 | | | Volts | |
| Input Low Voltage | | | 0.8 | Volts | |
| Input Current | | | ± 10 | μA | |
| Driver Short-Circuit Current | | | ± 250 | mA | $-7V \leq V_O \leq +12V$ |
| $V_{OUT} = HIGH$ | | | ± 250 | mA | $-7V \leq V_O \leq +12V$ |
| $V_{OUT} = LOW$ | | | | | |
| SP3493 DRIVER | | | | | |
| AC Characteristics | | | | | |
| Maximum Data Rate | 250 | | | kbps | |
| Driver Input to Output, t_{PLH} | 400 | 900 | 1500 | ns | <i>Figures 2 and 8</i> |
| Driver Input to Output, t_{PHL} | 400 | 900 | 1500 | ns | <i>Figures 2 and 8</i> |
| Differential Driver Skew | | 10 | | ns | $ t_{PHL}(Y) - t_{PLH}(Y) , t_{PHL}(Z) - t_{PLH}(Z) $, <i>Figures 2 and 8</i> |
| Driver Rise or Fall Time | | 10 | 30 | ns | From 10% to 90%; <i>Figures 3 and 9</i> |
| SP3493 RECEIVER | | | | | |
| DC Characteristics | | | | | |
| Differential Input Threshold | 0.2 | | +0.2 | Volts | $-7V \leq V_{CM} \leq 12V$ |
| Input Hysteresis | | 25 | | mV | $V_{CM} = 0V$ |
| Output Voltage High | $V_{CC}-0.4$ | | | Volts | $I_O = -1.5mA, V_{ID} = +200mV$ |
| Output Voltage Low | | | 0.4 | Volts | $I_O = +2.5mA, V_{ID} = -200mV$ |
| Input Resistance | 12 | 15 | | k Ω | $-7V \leq V_{CM} \leq 12V$ |
| Input Current (A, B); $V_{IN} = 12V$ | | | 1.0 | mA | $V_{IN} = 12V$ |
| Input Current (A, B); $V_{IN} = -7V$ | | | -0.8 | mA | $V_{IN} = -7V$ |
| Short-Circuit Current | | | 60 | mA | $0V \leq V_O \leq V_{CC}$ |

SPECIFICATIONS (continued)

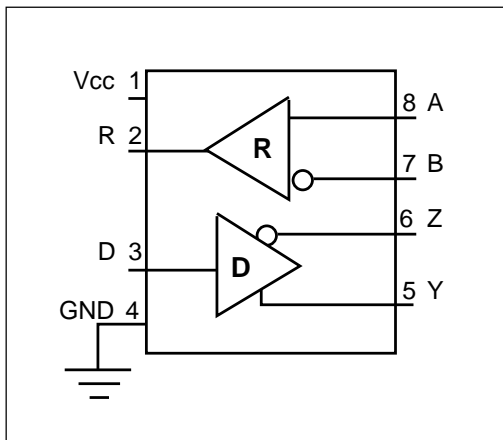
$T_{AMB} = T_{MIN}$ to T_{MAX} and $V_{CC} = 3.3V \pm 5\%$ unless otherwise noted.

| PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|--|----------------|------|-----------|------------|--|
| SP3493 RECEIVER | | | | | |
| AC Characteristics | | | | | |
| Maximum Data Rate | 250 | | | kbps | |
| Receiver Input to Output, t_{PLH} | 35 | 70 | 120 | ns | Figures 6 and 11 |
| Receiver Input to Output, t_{PHL} | 35 | 70 | 120 | ns | Figures 6 and 11 |
| Differential Receiver Skew | | 10 | | ns | Figures 6 and 11 |
| SP3493 POWER REQUIREMENTS | | | | | |
| Supply Current | | 1000 | 2000 | μA | $D = \emptyset$ or V_{CC} |
| SP3494 DRIVER | | | | | |
| DC Characteristics | | | | | |
| Differential Output Voltage | GND | | V_{CC} | Volts | Unloaded; $R = \infty$; Figure 1 |
| Differential Output Voltage | 2 | | V_{CC} | Volts | with load; $R = 50\Omega$; (RS-422); Figure 1 |
| Differential Output Voltage | 1.5 | | V_{CC} | Volts | with load; $R = 27\Omega$; (RS-485); Figure 1 |
| Change in Magnitude of Driver Differential Output Voltage for Complimentary States | | | 0.2 | Volts | $R = 27\Omega$ or $R = 50\Omega$; Figure 1 |
| Driver Common-Mode Output Voltage | | | 3 | Volts | $R = 27\Omega$ or $R = 50\Omega$; Figure 1 |
| Input High Voltage | 2.0 | | | Volts | Applies to DE, DI, \overline{RE} |
| Input Low Voltage | | | 0.8 | Volts | Applies to DE, DI, \overline{RE} |
| Input Current | | | ± 10 | μA | Applies to DE, DI, \overline{RE} |
| Driver Short-Circuit Current | | | | | |
| $V_{OUT} = \text{HIGH}$ | | | ± 250 | mA | $-7V \leq V_O \leq +12V$ |
| $V_{OUT} = \text{LOW}$ | | | ± 250 | mA | $-7V \leq V_O \leq +12V$ |
| SP3494 DRIVER | | | | | |
| AC Characteristics | | | | | |
| Maximum Data Rate | 2.5 | | | Mbps | $\overline{RE} = V_{CC}$, $DE = V_{CC}$ |
| Driver Input to Output, t_{PLH} | 20 | 45 | 75 | ns | Figures 2 and 8 |
| Driver Input to Output, t_{PHL} | 20 | 45 | 75 | ns | Figures 2 and 8 |
| Differential Driver Skew | | 10 | | ns | $ t_{DO1} - t_{DO2} $, Figures 2 and 9 |
| Driver Rise or Fall Time | | 30 | 70 | ns | From 10% to 90%, Figures 3 and 9 |
| Driver Enable to Output High | | 52 | 120 | ns | Figures 4 and 10 |
| Driver Enable to Output Low | | 60 | 120 | ns | Figures 5 and 10 |
| Driver Disable Time from Low | | 40 | 120 | ns | Figures 5 and 10 |
| Driver Disable Time from High | | 60 | 120 | ns | Figures 4 and 10 |
| SP3494 RECEIVER | | | | | |
| DC Characteristics | | | | | |
| Differential Input Threshold | -0.2 | | +0.2 | Volts | $-7V \leq V_{CM} \leq +12V$ |
| Input Hysteresis | | 20 | | mV | $V_{CM} = 0V$ |
| Output Voltage High | $V_{CC} - 0.4$ | | | Volts | $V_{ID} = +200mV$, $-1.5mA$ |
| Output Voltage Low | | | 0.4 | Volts | $V_{ID} = -200mV$, $2.5mA$ |
| Three-State (High Impedance) Output Current | | | ± 1 | μA | $0V \leq V_O \leq V_{CC}$; $\overline{RE} = V_{CC}$ |
| Input Resistance | 12 | 15 | | k Ω | $-7V \leq V_{CM} \leq +12V$ |
| Input Current (A, B); $V_{IN} = 12V$ | | | 1.0 | mA | $DE = 0V$, $V_{CC} = 0V$ or $3.6V$, $V_{IN} = 12V$ |
| Input Current (A, B); $V_{IN} = -7V$ | | | -0.8 | mA | $DE = 0V$, $V_{CC} = 0V$ or $3.6V$, $V_{IN} = -7V$ |
| Short-Circuit Current | 7 | | 60 | mA | $0V \leq V_{CM} \leq V_{CC}$ |

SPECIFICATIONS (continued)

$T_{AMB} = T_{MIN}$ to T_{MAX} and $V_{CC} = +3.3V \pm 5\%$ unless otherwise noted.

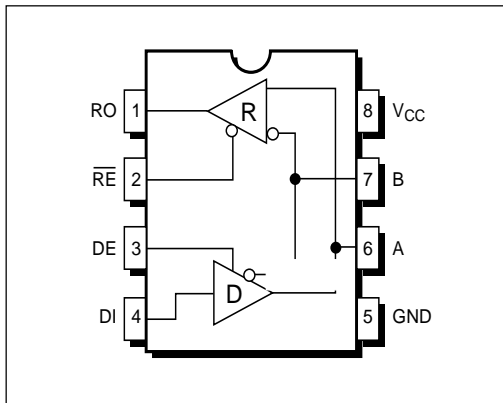
| PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|--|------|-------------|--------------|--------------------|---|
| SP3494 RECEIVER | | | | | |
| AC Characteristics | | | | | |
| Maximum Data Rate | 2.5 | | | Mbps | $\overline{RE} = 0V, DE = 0V$ |
| Receiver Input to Output, t_{PLH} | 40 | 70 | 100 | ns | <i>Figures 6 and 11</i> |
| Receiver Input to Output, t_{PHL} | 40 | 70 | 100 | ns | <i>Figures 6 and 11</i> |
| Differential Receiver Skew Receiver Enable to | | 10 | | ns | $t_{RSKEW} = t_{RPHL} - t_{RPLH} $, <i>Figures 6 and 11</i> |
| Output Low Receiver Enable to | | 35 | 60 | ns | <i>Figures 7 and 12; S₁ closed, S₂ open</i> |
| Output High Receiver Disable from Low | | 35 | 60 | ns | <i>Figures 7 and 12; S₂ closed, S₁ open</i> |
| Receiver Disable from High | | 35 | 60 | ns | <i>Figures 7 and 12; S₂ closed, S₁ open</i> |
| SP3494 SHUTDOWN TIMING | | | | | |
| Time to Shutdown | 50 | 75 | 200 | ns | $\overline{RE} = 3.3V, DE = 0V$ |
| Driver Enable from Shutdown to Output High | | 65 | 150 | ns | <i>Figures 4 and 10</i> |
| Driver Enable from Shutdown to Output Low | | 65 | 150 | ns | <i>Figures 5 and 10</i> |
| Receiver Enable from Shutdown to Output High | | 50 | 200 | ns | <i>Figures 7 and 12; S₂ closed, S₁ open</i> |
| Receiver Enable from Shutdown to Output Low | | 50 | 200 | ns | <i>Figures 7 and 12; S₁ closed, S₂ open</i> |
| SP3494 POWER REQUIREMENTS | | | | | |
| Supply Current No Load | | 1000 800 | 2000 1500 | μA μA | $\overline{RE}, DI = 0V$ or V_{CC} ; $DE = V_{CC}$ $\overline{RE} = 0V, DI = 0V$ or V_{CC} ; $DE = 0V$ |
| Shutdown Mode | | | 10 | μA | $DE = 0V, \overline{RE} = V_{CC}$ |



SP3493
Pinout

PIN FUNCTION - SP3493

- Pin 1 - V_{CC} - Positive supply $+3.00 < V_{CC} < +3.60$
- Pin 2 - R - Receiver output.
- Pin 3 - D - Driver input.
- Pin 4 - GND - Ground connection.
- Pin 5 - Y - Non-inverting driver output.
- Pin 6 - Z - Inverting driver output.
- Pin 7 - B - Inverting receiver input.
- Pin 8 - A - Non-inverting receiver input.



SP3494
Pinout

PIN FUNCTION - SP3494

- Pin 1 - RO - Receiver Output.
- Pin 2 - \overline{RE} - Receiver Output Enable Active LOW.
- Pin 3 - DE - Driver Output Enable Active HIGH.
- Pin 4 - DI - Driver Input.
- Pin 5 - GND - Ground Connection.
- Pin 6 - A - Driver Output/Receiver Input Non-inverting.
- Pin 7 - B - Driver Output/Receiver Input Inverting.
- Pin 8 - V_{CC} - Positive Supply $+3.00V < V_{CC} < +3.60V$

DESCRIPTION

The **SP3493/3494** are +3.3V transceivers that meet the electrical specifications of the RS-485 and RS-422 serial protocols. The **SP3493/3494** feature Sipex's BiCMOS process allowing low power operation without sacrificing performance.

The **SP3493** device is a +3.3V full-duplex transceiver that is pin-to-pin compatible with the **Sipex SP3490** and **SP490** devices as well as popular industry standards such as the MAX3488, the LTC490, and the 75179. The **SP3493** has a slew-rate limited driver with a data transmission rate of 250kbps.

The **SP3494** device is a +3.3V half-duplex transceiver that is pin-to-pin compatible with the **Sipex SP3481** and **SP481** devices as well as popular industry standards such as the MAX3486 and the 75176. The **SP3494** has a slew-rate limited driver with a data transmission rate of 2.5Mbps.

Drivers

The **SP3493/3494** devices both have differential outputs. The typical voltage output swing with no load will be 0V to V_{CC} . With worst case loading of 54Ω across the differential outputs, the driver can maintain greater than 1.5V voltage levels.

The **SP3494** device has an enable control line which is active HIGH. A logic HIGH on DE (pin 3) will enable the differential driver outputs. A logic LOW on DE (pin 3) will force the driver outputs at high impedance (high-Z). The **SP3493** device does not have a driver enable.

The slew-rate limited **SP3493/SP3494** drivers will operate up to 250kbps and 2.5Mbps, respectively. In addition to adhering to the 250mA I_{sc} maximum limit on the driver output, the driver output short-circuit protection will allow the devices to withstand an infinite short circuit over the -7.0V to +12V common mode range without damage.

Receivers

The receivers have differential inputs with an input sensitivity as low as $\pm 200\text{mV}$. Input impedance of the receivers is typically $15\text{k}\Omega$ ($12\text{k}\Omega$ minimum). A wide common mode range of -7V to +12V allows for large ground potential differences between systems.

Both the **SP3493/SP3494** receivers are equipped with fail-safe which guarantees that the receiver outputs will be in a high state when the input is left unconnected.

The **SP3494** receiver has a high impedance (high-Z) enable control pin. A logic LOW on $\overline{\text{RE}}$ (pin 2) will enable the receiver; a logic HIGH on $\overline{\text{RE}}$ (pin 2) will disable the receiver.

The **SP3494** is equipped with a shutdown mode. To enable the shutdown state, both the driver and receiver must be disabled simultaneously. A logic LOW on DE (pin 3) and a logic HIGH on $\overline{\text{RE}}$ (pin 2) will put the **SP3494** into shutdown. In shutdown, the supply current will drop to 2nA typical, $1\mu\text{A}$ maximum.

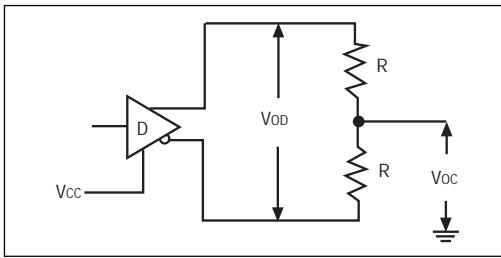


Figure 1. Driver DC Test Load Circuit

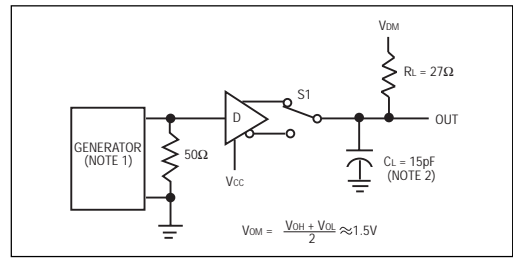


Figure 2. Driver Propagation Delay Test Circuit

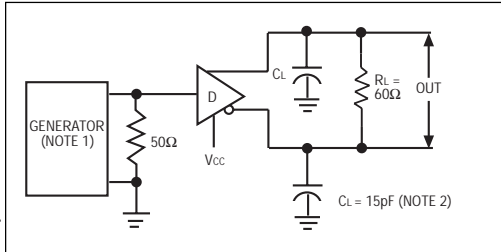


Figure 3. Driver Differential Output Delay and Transition Time Circuit

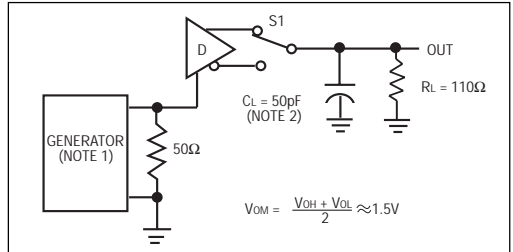


Figure 4. Driver Enable and Disable Timing Circuit, output HIGH

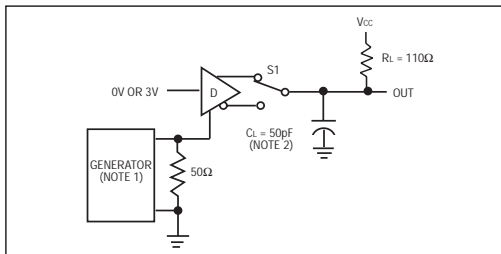


Figure 5. Driver Enable and Disable Timing Circuit, Output LOW

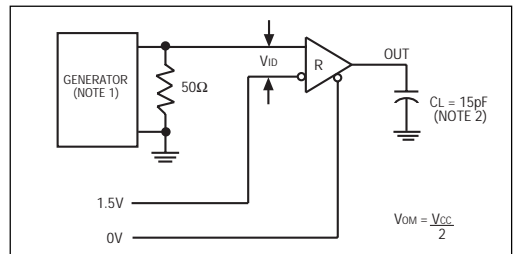


Figure 6. Receiver Propagation Delay Test Circuit

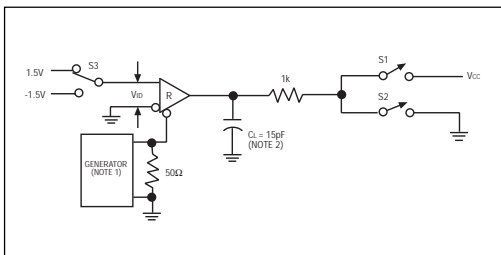


Figure 7. Receiver Enable and Disable Timing Circuit

| INPUTS | | | LINE CONDITION | OUTPUTS | |
|-----------------|----|----|----------------|---------|---|
| \overline{RE} | DE | DI | | B | A |
| X | 1 | 1 | No Fault | 0 | 1 |
| X | 1 | 0 | No Fault | 1 | 0 |
| X | 0 | X | X | Z | Z |

Table 1. Transmit Function Truth Table

| INPUTS | | A - B | OUTPUTS |
|-----------------|----|-------------|---------|
| \overline{RE} | DE | | R |
| 0 | 0 | +0.2V | 1 |
| 0 | 0 | -0.2V | 0 |
| 0 | 0 | Inputs Open | 1 |
| 1 | 0 | X | Z |

Table 2. Receive Function Truth Table

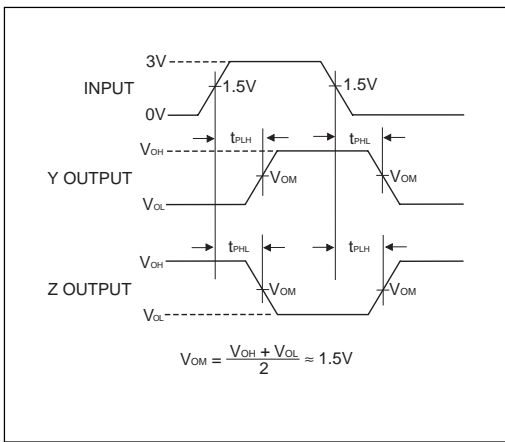


Figure 8. Driver Propagation Delay Waveforms

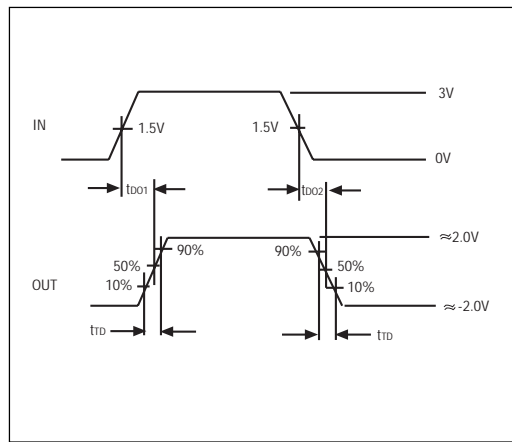


Figure 9. Driver Differential Output Delay and Transition Time Waveforms

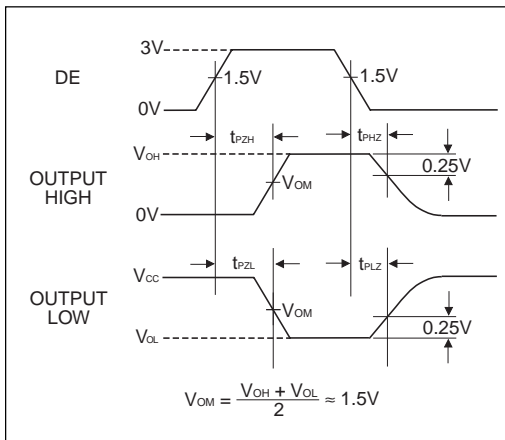


Figure 10. Driver Enable and Disable Timing Waveforms

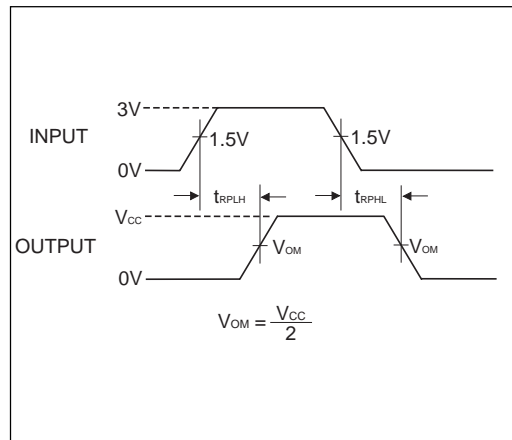


Figure 11. Receiver Propagation Delay Waveforms

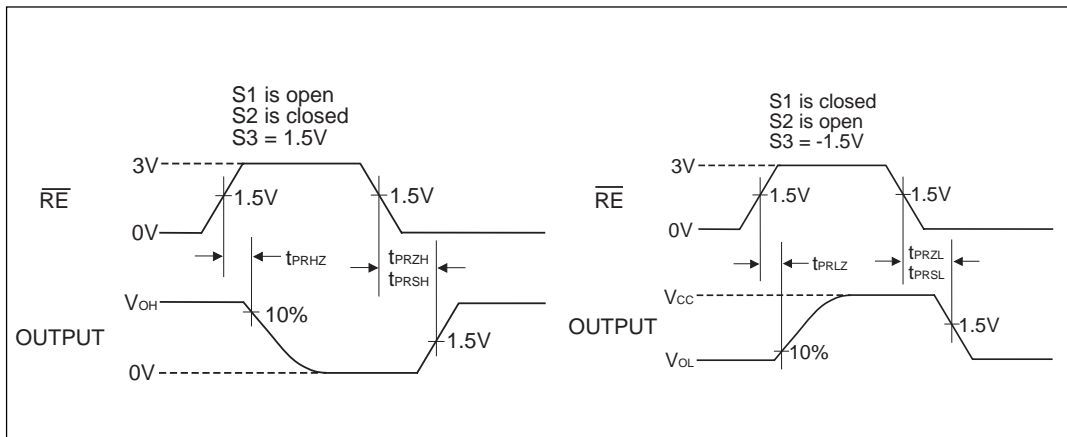


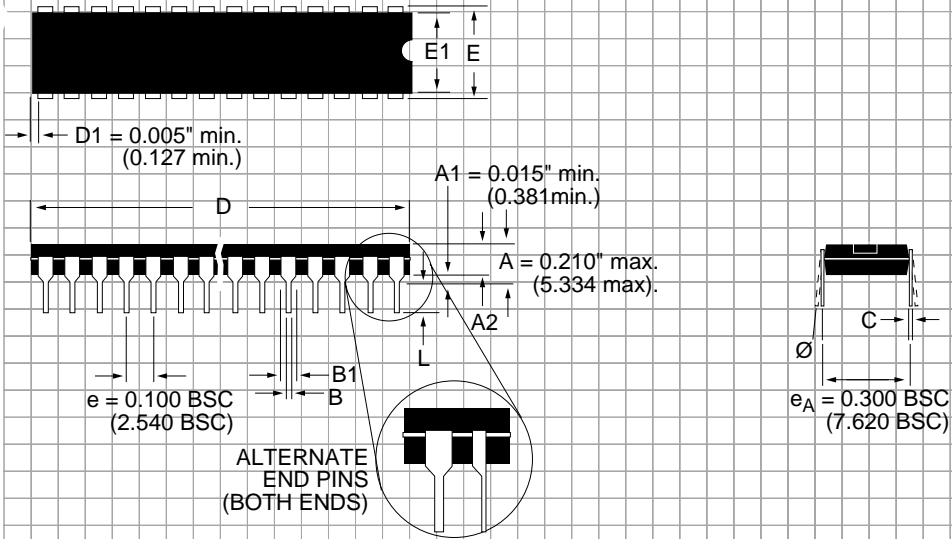
Figure 12. Receiver Enable and Disable Waveforms

NOTE 1: The input pulse is supplied by a generator with the following characteristics:

PRR=250KHz, 50% duty cycle, $t_r < 6.0ns$, $Z_0=50\Omega$.

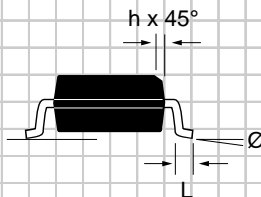
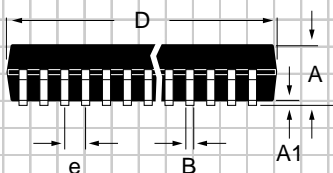
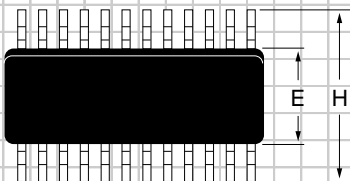
NOTE 2: C_L includes probe and stray capacitance.

**PACKAGE: PLASTIC
DUAL-IN-LINE
(NARROW)**



| DIMENSIONS (Inches) Minimum/Maximum (mm) | 8-PIN |
|--|-------------------------------|
| A2 | 0.115/0.195 (2.921/4.953) |
| B | 0.014/0.022 (0.356/0.559) |
| B1 | 0.045/0.070 (1.143/1.778) |
| C | 0.008/0.014 (0.203/0.356) |
| D | 0.355/0.400 (9.017/10.160) |
| E | 0.300/0.325 (7.620/8.255) |
| E1 | 0.240/0.280 (6.096/7.112) |
| L | 0.115/0.150 (2.921/3.810) |
| \emptyset | 0°/15° (0°/15°) |

**PACKAGE: PLASTIC
SMALL OUTLINE (SOIC)
(NARROW)**



| DIMENSIONS (Inches) Minimum/Maximum (mm) | 8-PIN |
|--|------------------------------|
| A | 0.053/0.069 (1.346/1.748) |
| A1 | 0.004/0.010 (0.102/0.249) |
| B | 0.014/0.019 (0.35/0.49) |
| D | 0.189/0.197 (4.80/5.00) |
| E | 0.150/0.157 (3.802/3.988) |
| e | 0.050 BSC (1.270 BSC) |
| H | 0.228/0.244 (5.801/6.198) |
| h | 0.010/0.020 (0.254/0.498) |
| L | 0.016/0.050 (0.406/1.270) |
| Ø | 0°/8° (0°/8°) |

ORDERING INFORMATION

| Model | Temperature Range | Package |
|--------------------|----------------------------|---------------------|
| SP3493CN | . 0°C to +70°C | . 8-pin Narrow SOIC |
| SP3493CP | . 0°C to +70°C | . 8-pin Plastic DIP |
| SP3493EN | ..-40°C to +85°C | . 8-pin Narrow SOIC |
| SP3493EP | ..-40°C to +85°C | . 8-pin Plastic DIP |
| SP3494CN | . 0°C to +70°C | . 8-pin Narrow SOIC |
| SP3494CP | . 0°C to +70°C | . 8-pin Plastic DIP |
| SP3494EN | ..-40°C to +85°C | . 8-pin Narrow SOIC |
| SP3494EP | ..-40°C to +85°C | . 8-pin Plastic DIP |

Please consult the factory for pricing and availability on a Tape-On-Reel option.



SIGNAL PROCESSING EXCELLENCE

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