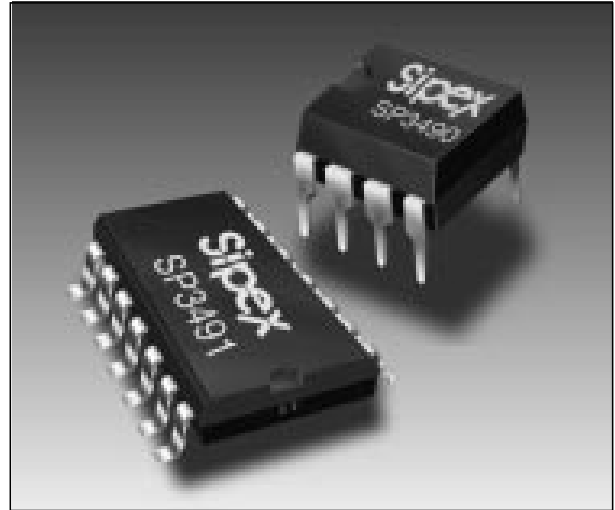


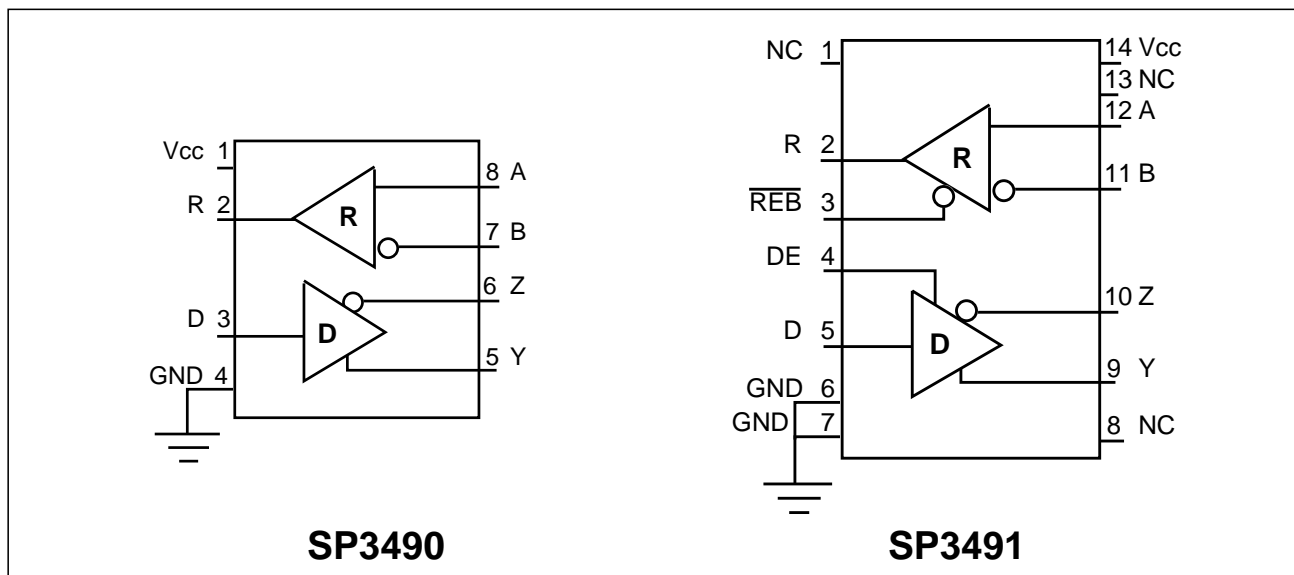
## +3.3V Low Power Full Duplex RS-485 Transceivers with 10Mbps Data Rate

- Full Duplex RS-485 and RS-422 Transceivers
- Operates from a single +3.3V supply
- Interoperable with +5.0V logic
- Driver/Receiver Tri-state Enable Lines (**SP3491**)
- -7V to +12V Common-Mode Input Voltage Range
- $\pm 200\text{mV}$  Receiver Input Sensitivity
- Allows up to 32 transceivers on the serial bus
- Compatibility with LTC490 and SN75179 (**SP3490**)
- Compatibility with LTC491 and SN75180 (**SP3491**)



### DESCRIPTION

The **SP3490** and the **SP3491** are +3.3V low power full duplex transceivers that meet the specifications of the RS-485 and RS-422 serial protocols. These devices are pin-to-pin compatible with the **Sipex** SP490 and SP491 devices as well as popular industry standards. The **SP3490** and the **SP3491** feature **Sipex's** BiCMOS process, allowing low power operation without sacrificing performance. The **SP3490** and **SP3491** meet the electrical specifications of RS-485 and RS-422 serial protocols up to 10Mbps under load. The **SP3491** is identical to the **SP3490** with the addition of driver and receiver tri-state 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 NSOIC (derate 6.90mW/°C above +70°C).....  | 600mW                      |
| 8-pin PDIP (derate 11.8mW/°C above +70°C).....   | 1000mW                     |
| 14-pin NSOIC (derate 8.33mW/°C above +70°C)..... | 700mW                      |
| 14-pin PDIP (derate 14.3mW/°C above +70°C).....  | 1200mW                     |



**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  |
|---|--------------|------|-----------|------------|---|
| <b>SP3490 DRIVER</b>                                      |              |      |           |            |   |
| <b>DC Characteristics</b>                                 |              |      |           |            |   |
| 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   |              |      | $\pm 10$  | $\mu A$    |   |
| Driver Short-Circuit Current                              |              |      | $\pm 250$ | mA         | $-7V \leq V_O \leq +12V$  |
| $V_{OUT} = HIGH$  |              |      | $\pm 250$ | mA         | $-7V \leq V_O \leq +12V$  |
| $V_{OUT} = LOW$   |              |      |           |            |   |
| <b>SP3490 DRIVER</b>                                      |              |      |           |            |   |
| <b>AC Characteristics</b>                                 |              |      |           |            |   |
| Maximum Data Rate   | 10           |      |           | Mbps       |   |
| Driver Input to Output, $t_{PLH}$                         | 20           | 40   | 60        | ns         | $R=27\Omega$ , <i>Figures 2 and 8</i>   |
| Driver Input to Output, $t_{PHL}$                         | 20           | 40   | 60        | ns         | $R=27\Omega$ , <i>Figures 2 and 8</i>   |
| Differential Driver Skew                                  |              | 2    |           | ns         | $ t_{PHL}(Y) - t_{PLH}(Y) ,  t_{PHL}(Z) - t_{PLH}(Z) $ , <i>Figures 2 and 8</i> |
| Driver Rise or Fall Time                                  |              | 5    | 20        | ns         | From 10% to 90%; <i>Figures 3 and 9</i>   |
| <b>SP3490 RECEIVER</b>                                    |              |      |           |            |   |
| <b>DC Characteristics</b>                                 |              |      |           |            |   |
| 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 $\Omega$ | $-7V \leq V_{CM} \leq 12V$  |
| 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   |
|-------------------------------------|------|-------------|--------------|----------|--|
| <b>SP3490 RECEIVER</b>              |      |             |              |          |  |
| <b>AC Characteristics</b>           |      |             |              |          |  |
| Maximum Data Rate                   | 10   |             |              | Mbps     | <i>Figures 6 and 11</i><br>$T_{AMB} = 25^{\circ}C, V_{CC} = 3.3V, \text{Figures 6 and 11}$ |
| Receiver Input to Output, $t_{PLH}$ | 40   | 70          | 120<br>85    | ns<br>ns |  |
| Receiver Input to Output, $t_{PHL}$ | 40   | 70          | 120<br>85    | ns<br>ns | <i>Figures 6 and 11</i><br>$T_{AMB} = 25^{\circ}C, V_{CC} = 3.3V, \text{Figures 6 and 11}$ |
| Differential Receiver Skew          |      | 4           |              | ns       | $ t_{PHL}(A) - t_{PLH}(A) ,  t_{PHL}(B) - t_{PLH}(B) ,$<br><i>Figures 6 and 11</i>         |
| <b>POWER REQUIREMENTS</b>           |      |             |              |          |  |
| Supply Voltage                      | +3.0 |             | +3.6         | Volts    | $DE = V_{CC}$<br>$DE = 0$  |
| Supply Current                      |      | 1000<br>800 | 2000<br>1500 | $\mu A$  |  |

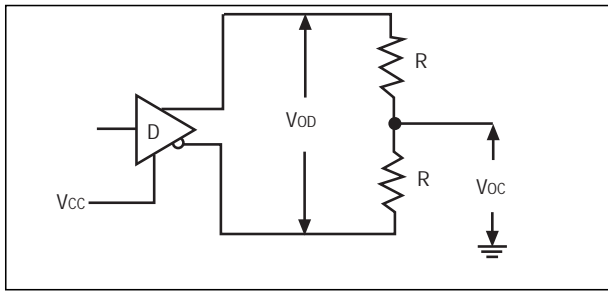


Figure 1. Driver DC Test Load Circuit

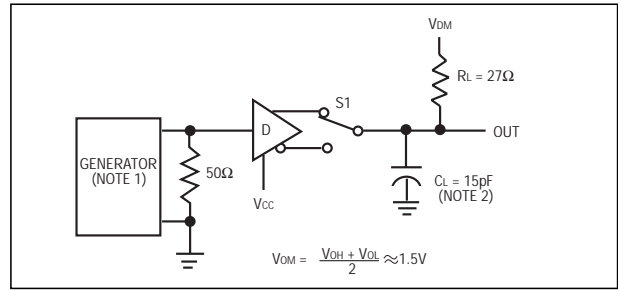


Figure 2. Driver Propagation Delay Test Circuit

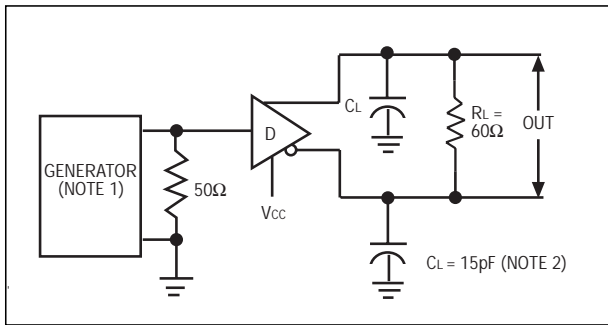


Figure 3. Driver Differential Output Delay and Transition Time Circuit

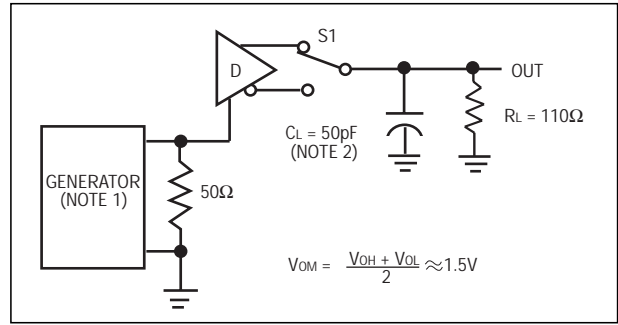


Figure 4. Driver Enable and Disable Timing Circuit, Output HIGH

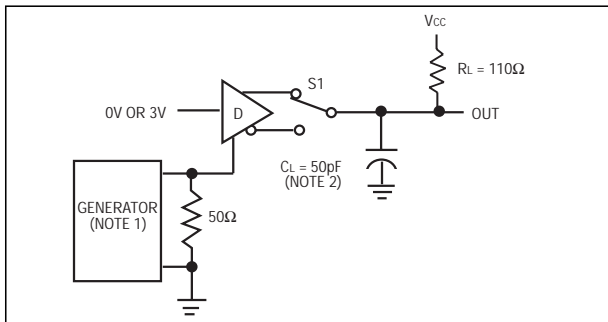


Figure 5. Driver Enable and Disable Timing Circuit, Output LOW

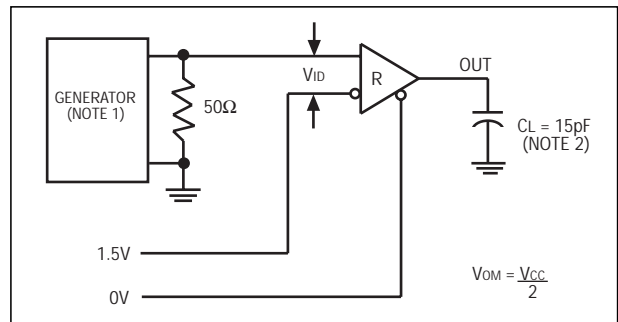


Figure 6. Receiver Propagation Delay Test Circuit

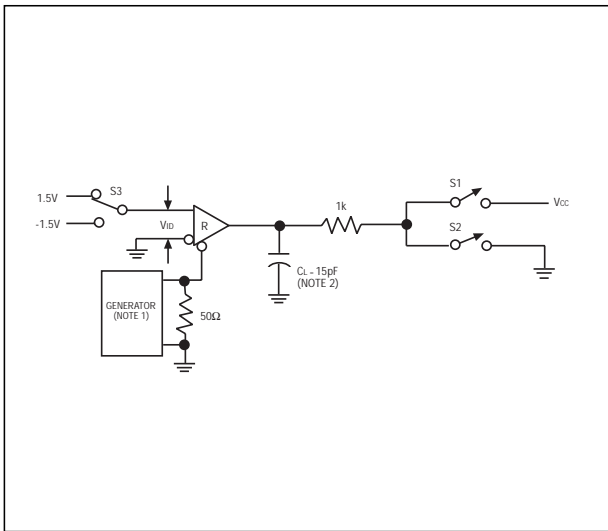


Figure 7. Receiver Enable and Disable Timing Circuit

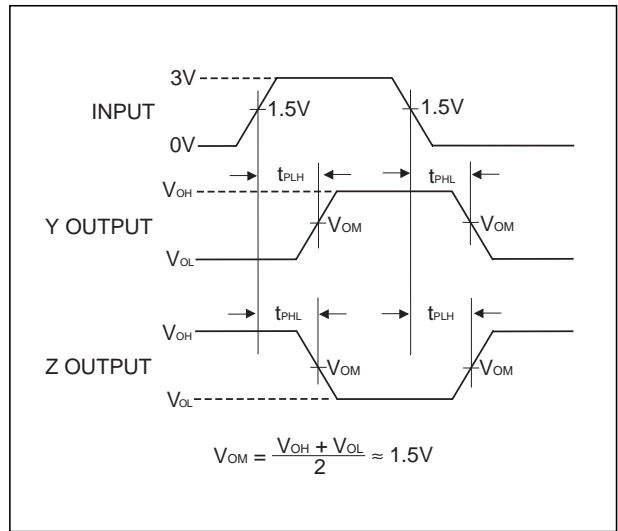


Figure 8. Driver Propagation Delay Waveforms

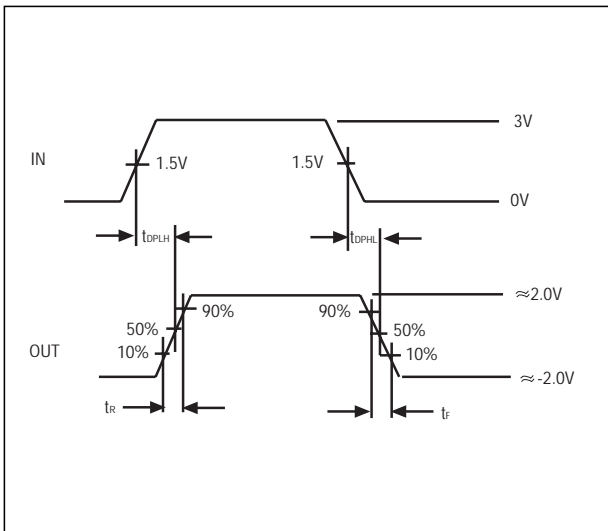


Figure 9. Driver Differential Output Delay and Transition Time Waveforms

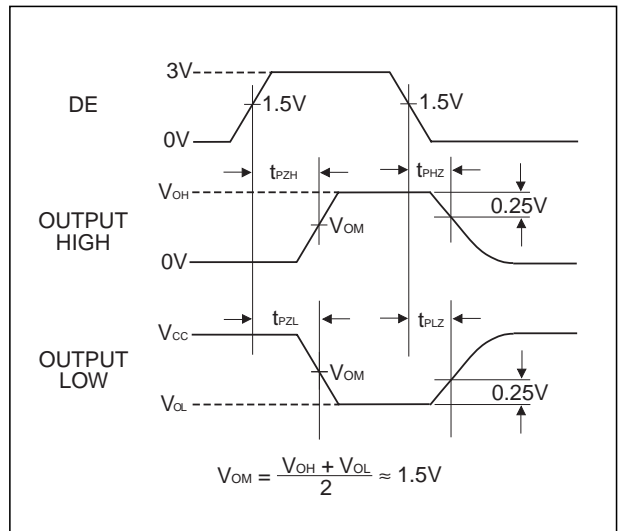


Figure 10. Driver Enable and Disable Timing Waveforms

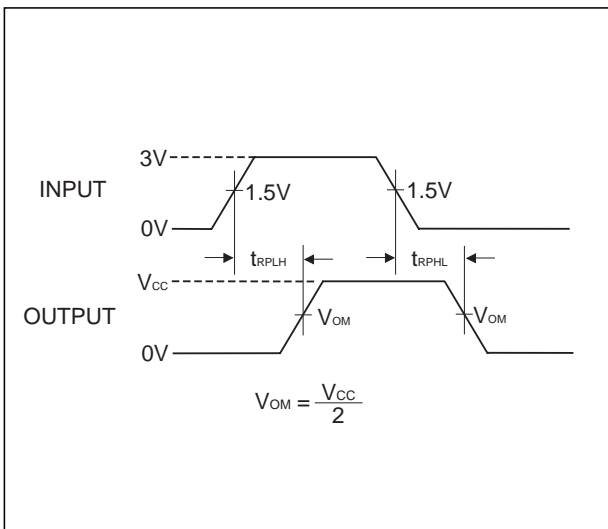


Figure 11. Receiver Propagation Delay Waveforms

# SPECIFICATIONS

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

| PARAMETERS   | MIN. | TYP. | MAX.      | UNITS   | CONDITIONS  |
|--|------|------|-----------|---------|---|
| <b>SP3491 DRIVER</b>   |      |      |           |         |   |
| <b>DC Characteristics</b>  |      |      |           |         |   |
| Differential Output Voltage  | GND  |      | $V_{CC}$  | Volts   | Unloaded; $R = \infty$ ; <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  | 1.5  |      | $V_{CC}$  | Volts   | With Load; $R = 27\Omega$ ; (RS-485); <i>Figure 1</i>                           |
| Change in Magnitude of Driver 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   | Applies to D, REB, DE   |
| Input LOW Voltage  |      |      | 0.8       | Volts   | Applies to D, REB, DE   |
| Input Current  |      |      | $\pm 10$  | $\mu A$ | Applies to D, REB, DE   |
| Driver Short-Circuit Current   |      |      | $\pm 250$ | mA      | $-7V \leq V_O \leq +12V$  |
| $V_{OUT} = HIGH$   |      |      | $\pm 250$ | mA      | $-7V \leq V_O \leq +12V$  |
| $V_{OUT} = LOW$  |      |      |           |         |   |
| <b>SP3491 DRIVER</b>   |      |      |           |         |   |
| <b>AC Characteristics</b>  |      |      |           |         |   |
| Maximum Data Rate  | 10   |      |           | Mbps    |   |
| Driver Input to Output, $t_{PLH}$  | 20   | 40   | 60        | ns      | <i>Figures 2 and 8</i>  |
| Driver Input to Output, $t_{PHL}$  | 20   | 40   | 60        | ns      | <i>Figures 2 and 8</i>  |
| Differential Driver Skew   |      | 2    |           | ns      | $ t_{PHL}(Y) - t_{PLH}(Y) ,  t_{PHL}(Z) - t_{PLH}(Z) $ , <i>Figures 2 and 8</i> |
| Driver Rise or Fall Time   |      | 5    | 20        | ns      | From 10% to 90%; <i>Figures 3 and 9</i>   |
| Driver Enable to Output HIGH   |      | 52   | 120       | ns      | <i>Figures 4 and 10</i>   |
| Driver Enable to Output LOW  |      | 60   | 120       | ns      | <i>Figures 5 and 10</i>   |
| Driver Disable from LOW  |      | 40   | 120       | ns      | <i>Figures 5 and 10</i>   |
| Driver Disable from HIGH   |      | 60   | 120       | ns      | <i>Figures 4 and 10</i>   |

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

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

**NOTE 2:**  $C_L$  includes probe and stray capacitance.

## 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   |
|--------------------------------------|--------------|------|---------|------------|--|
| <b>SP3491 RECEIVER</b>               |              |      |         |            |  |
| <b>DC Characteristics</b>            |              |      |         |            |  |
| 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      | $I_O = +2.5mA, V_{ID} = -200mV$  |
| Three State (high impedance)         |              |      |         |            |  |
| Output Current                       |              |      | $\pm 1$ | $\mu A$    | $0V \leq V_O \leq V_{CC}; \overline{REB} = V_{CC}$                                   |
| Input Resistance                     | 12           | 15   |         | k $\Omega$ | $-7V \leq V_{CM} \leq 12V$   |
| 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                |              |      | 60      | mA         | $0V \leq V_O \leq V_{CC}$  |
| <b>SP3491 RECEIVER</b>               |              |      |         |            |  |
| <b>AC Characteristics</b>            |              |      |         |            |  |
| Maximum Data Rate                    | 10           |      |         | Mbps       | $\overline{REB} = 0V, DE = V_{CC}$   |
| Receiver Input to Output, $t_{PLH}$  | 40           | 70   | 120     | ns         | <i>Figures 6 &amp; 11</i>  |
|                                      |              |      | 85      | ns         | $T_{AMB} = +25^\circ C, V_{CC} = +3.3V,$<br><i>Figures 6 and 11</i>                  |
| Receiver Input to Output, $t_{PHL}$  | 40           | 70   | 120     | ns         | <i>Figures 6 &amp; 11</i>  |
|                                      |              |      | 85      | ns         | $T_{AMB} = +25^\circ C, V_{CC} = +3.3V,$<br><i>Figures 6 and 11</i>                  |
| Differential Receiver Skew           |              | 4    |         | ns         | $ t_{PHL}(A) - t_{PLH}(A) ,  t_{PHL}(B) - t_{PLH}(B) ,$<br><i>Figures 6 &amp; 11</i> |
| Receiver Enable to Output LOW        |              | 65   | 150     | ns         | <i>Figures 7 and 12; S<sub>1</sub> closed, S<sub>2</sub> open</i>                    |
| Receiver Enable to Output HIGH       |              | 65   | 150     | ns         | <i>Figures 7 and 12; S<sub>2</sub> closed, S<sub>1</sub> open</i>                    |
| Receiver Disable from LOW            |              | 65   | 200     | ns         | <i>Figures 7 and 12; S<sub>1</sub> closed, S<sub>2</sub> open</i>                    |
| Receiver Disable from HIGH           |              | 65   | 200     | ns         | <i>Figures 7 and 12; S<sub>2</sub> closed, S<sub>1</sub> open</i>                    |
| <b>POWER REQUIREMENTS</b>            |              |      |         |            |  |
| Supply Voltage                       | +3.0         |      | +3.6    | Volts      | $\overline{REB}, D = 0V$ or $V_{CC}; DE = V_{CC}$                                    |
| Supply Current                       |              | 1000 | 2000    | $\mu A$    | $DE=0V$  |
|                                      |              | 800  | 1500    | $\mu A$    |  |

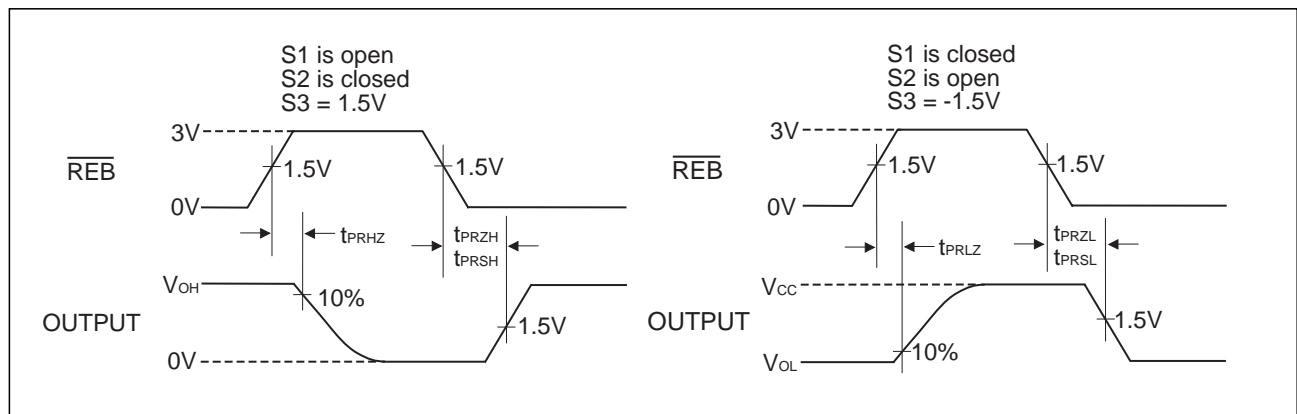


Figure 12. Receiver Enable and Disable Waveforms

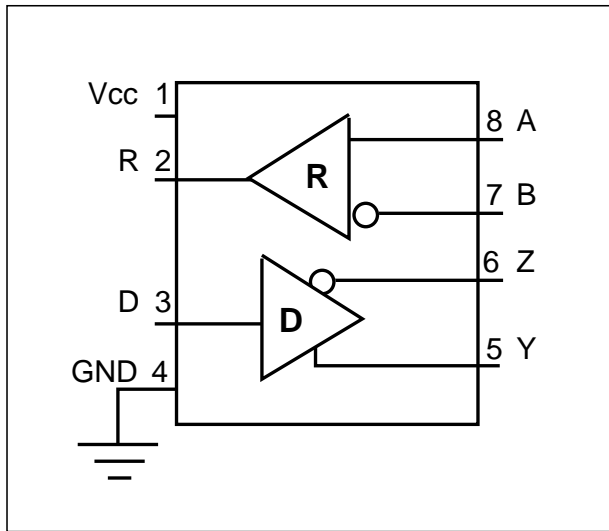


Figure 13. Pinout for the SP3490

### PIN FUNCTION - SP3490

- 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.

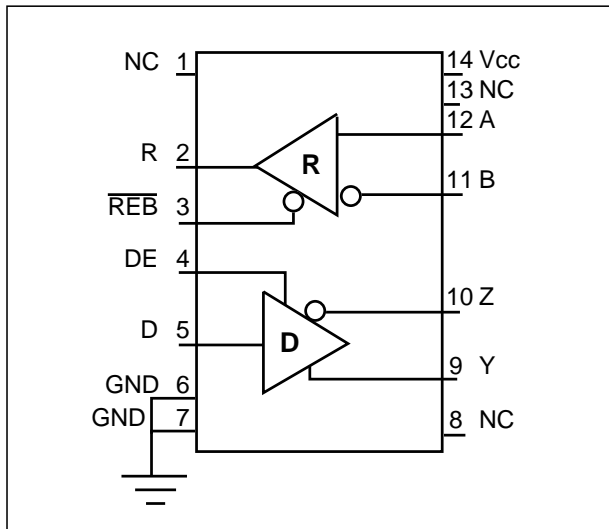


Figure 14. Pinout for the SP3491

### PIN FUNCTION - SP3491

- Pin 1 - NC - No connect.
- Pin 2 - R - Receiver output.
- Pin 3 - REB - Receiver output enable active LOW.
- Pin 4 - DE - Driver output enable active HIGH.
- Pin 5 - D - Driver input.
- Pin 6 - GND - Ground connection.
- Pin 7 - GND - Ground connection.
- Pin 8 - NC - No connect.
- Pin 9 - Y - Non-inverting driver output.
- Pin 10 - Z - Inverting driver output.
- Pin 11 - B - Inverting receiver input.
- Pin 12 - A - Non-inverting receiver input.
- Pin 13 - NC - No connect.
- Pin 14 -  $V_{CC}$  - Positive supply  $+3.00 < V_{CC} < +3.60$

## DESCRIPTION

The **SP3490** and the **SP3491** are two members in the family of +3.3V low power full duplex transceivers that meet the electrical specifications of the RS-485 and RS-422 serial protocols. These devices are pin-to-pin compatible with the **Sipex SP490** and the **SP491** devices as well as popular industry standards. The **SP3490** and the **SP3491** feature **Sipex's** BiCMOS process allowing low power operation without sacrificing performance.

### Driver

The drivers for both the **SP3490** and **SP3491** have differential outputs. The typical voltage output swing with no load will be 0 volts to  $V_{CC}$ . With a load of  $54\Omega$  across the differential outputs, the driver maintains greater than 1.5V voltage levels.

The driver of the **SP3491** has a driver enable control line which is active high. A logic high on DE (pin 4) of the **SP3491** will enable the differential driver outputs. A logic low on DE (pin 4) of the **SP3491** will tri-state the driver outputs. The **SP3490** does not have a driver enable.

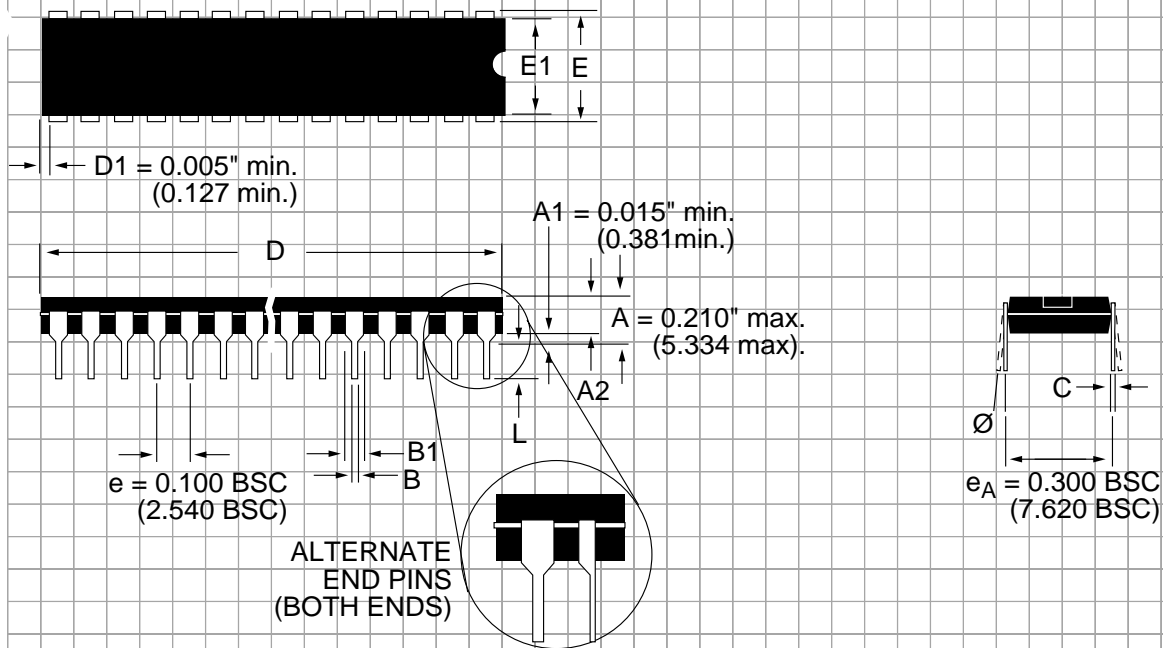
### Receiver

The receivers for the **SP3490** and **SP3491** have differential inputs with an input sensitivity as low as  $\pm 100\text{mV}$ . 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. The receivers for both the **SP3490** and **SP3491** are equipped with a fail-safe feature that guarantees the receiver output will be in a high state when the input is left unconnected.

The receiver of the **SP3491** has a receiver enable control line which is active low. A logic low on REB (pin 3) of the **SP3491** will enable the differential receiver. A logic high on REB (pin 3) of the **SP3491** will tri-state the receiver.

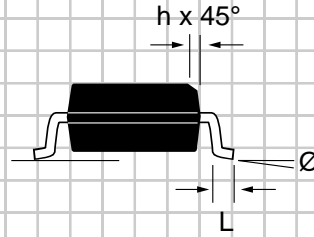
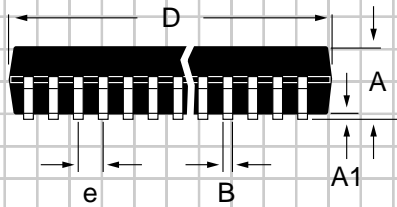
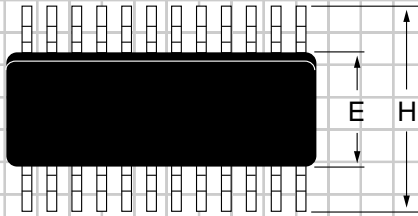


# PACKAGE: PLASTIC DUAL-IN-LINE (NARROW)



| DIMENSIONS (Inches)<br>Minimum/Maximum<br>(mm) | 8-PIN                         | 14-PIN                         |
|--|-------------------------------|--------------------------------|
| A2   | 0.115/0.195<br>(2.921/4.953)  | 0.115/0.195<br>(2.921/4.953)   |
| B  | 0.014/0.022<br>(0.356/0.559)  | 0.014/0.022<br>(0.356/0.559)   |
| B1   | 0.045/0.070<br>(1.143/1.778)  | 0.045/0.070<br>(1.143/1.778)   |
| C  | 0.008/0.014<br>(0.203/0.356)  | 0.008/0.014<br>(0.203/0.356)   |
| D  | 0.355/0.400<br>(9.017/10.160) | 0.735/0.775<br>(18.669/19.685) |
| E  | 0.300/0.325<br>(7.620/8.255)  | 0.300/0.325<br>(7.620/8.255)   |
| E1   | 0.240/0.280<br>(6.096/7.112)  | 0.240/0.280<br>(6.096/7.112)   |
| L  | 0.115/0.150<br>(2.921/3.810)  | 0.115/0.150<br>(2.921/3.810)   |
| $\varnothing$                                  | 0°/ 15°<br>(0°/15°)           | 0°/ 15°<br>(0°/15°)            |

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



| DIMENSIONS (Inches)<br>Minimum/Maximum<br>(mm) | 8-PIN                        | 14-PIN                       |
|--|------------------------------|------------------------------|
| A  | 0.053/0.069<br>(1.346/1.748) | 0.053/0.069<br>(1.346/1.748) |
| A1   | 0.004/0.010<br>(0.102/0.249) | 0.004/0.010<br>(0.102/0.249) |
| B  | 0.014/0.019<br>(0.35/0.49)   | 0.013/0.020<br>(0.330/0.508) |
| D  | 0.189/0.197<br>(4.80/5.00)   | 0.337/0.344<br>(8.552/8.748) |
| E  | 0.150/0.157<br>(3.802/3.988) | 0.150/0.157<br>(3.802/3.988) |
| e  | 0.050 BSC<br>(1.270 BSC)     | 0.050 BSC<br>(1.270 BSC)     |
| H  | 0.228/0.244<br>(5.801/6.198) | 0.228/0.244<br>(5.801/6.198) |
| h  | 0.010/0.020<br>(0.254/0.498) | 0.010/0.020<br>(0.254/0.498) |
| L  | 0.016/0.050<br>(0.406/1.270) | 0.016/0.050<br>(0.406/1.270) |
| Ø  | 0°/8°<br>(0°/8°)             | 0°/8°<br>(0°/8°)             |

## ORDERING INFORMATION

| Model              | Temperature Range          | Package        |
|--------------------|----------------------------|----------------|
| SP3490CN . . . . . | . 0°C to +70°C . . . . .   | . 8-Pin NSOIC  |
| SP3490CP . . . . . | . 0°C to +70°C . . . . .   | . 8-Pin DIP    |
| SP3490EN . . . . . | . -40°C to +85°C . . . . . | . 8-Pin NSOIC  |
| SP3490EP . . . . . | . -40°C to +85°C . . . . . | . 8-Pin DIP    |
|                    |                            |                |
| SP3491CN . . . . . | . 0°C to +70°C . . . . .   | . 14-Pin NSOIC |
| SP3491CP . . . . . | . 0°C to +70°C . . . . .   | . 14-Pin DIP   |
| SP3491EN . . . . . | . -40°C to +85°C . . . . . | . 14-Pin NSOIC |
| SP3491EP . . . . . | . -40°C to +85°C . . . . . | . 14-Pin DIP   |

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

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