

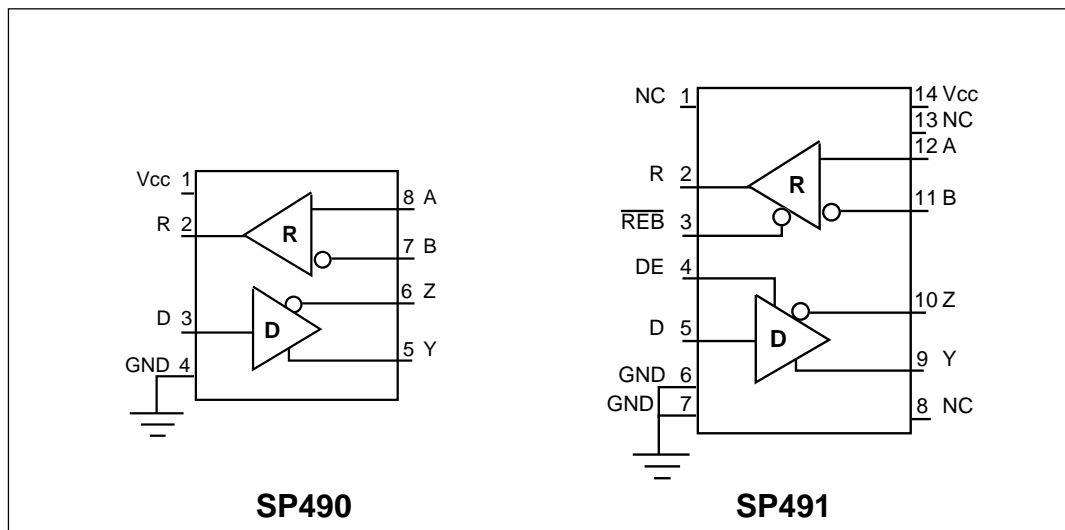
## Full Duplex RS-485 Transceivers

- +5V Only
- Low Power BiCMOS
- Driver/Receiver Enable (**SP491**)
- RS-485 and RS-422 Drivers/Receivers
- Pin Compatible with LTC490 and SN75179 (**SP490**)
- Pin Compatible with LTC491 and SN75180 (**SP491**)



### DESCRIPTION...

The **SP490** is a low power differential line driver/receiver meeting RS-485 and RS-422 standards up to 5Mbps. The **SP491** is identical to the **SP490** with the addition of driver and receiver tri-state enable lines. Both products feature  $\pm 200\text{mV}$  receiver input sensitivity, over wide common mode range. The **SP490** is available in 8-pin plastic DIP and 8-pin NSOIC packages for operation over the commercial and industrial temperature ranges. The **SP491** is available in 14-pin DIP and 14-pin NSOIC packages for operation over the commercial and industrial temperature ranges.



## 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 <sub>CC</sub> .....    | +7V                              |
| Input Voltages           |                                  |
| Drivers.....             | -0.5V to (V <sub>CC</sub> +0.5V) |
| Receivers.....           | ±14V                             |
| Output Voltages          |                                  |
| Drivers.....             | ±14V                             |
| Receivers.....           | -0.5V to (V <sub>CC</sub> +0.5V) |
| Storage Temperature..... | -65° C to +150°                  |
| Power Dissipation.....   | 1000mW                           |

## SPECIFICATIONS

T<sub>MIN</sub> to T<sub>MAX</sub> and V<sub>CC</sub> = 5V ± 5% unless otherwise noted.

| PARAMETERS  | MIN. | TYP. | MAX.            | UNITS | CONDITIONS  |
|---|------|------|-----------------|-------|---|
| <b>SP490 DRIVER</b>                                       |      |      |                 |       |   |
| <b>DC Characteristics</b>                                 |      |      |                 |       |   |
| Differential Output Voltage                               | GND  |      | V <sub>CC</sub> | Volts | Unloaded; R = ∞ ; <i>see figure 1</i>   |
| Differential Output Voltage                               | 2    |      | V <sub>CC</sub> | Volts | With Load; R = 50Ω; (RS422); <i>see figure 1</i>  |
| Differential Output Voltage Change in Magnitude of Driver | 1.5  |      | V <sub>CC</sub> | Volts | With Load; R = 27Ω; (RS485); <i>see figure 1</i>  |
| Differential Output Voltage for Complimentary States      |      |      | 0.2             | Volts | R = 27Ω or R = 50Ω; <i>see figure 1</i>   |
| Driver Common-Mode Output Voltage                         |      |      | 3               | Volts | R = 27Ω or R = 50Ω; <i>see figure 1</i>   |
| Input High Voltage  | 2.0  |      |                 | Volts | Applies to D  |
| Input Low Voltage   |      |      | 0.8             | Volts | Applies to D  |
| Input Current   |      |      | ±10             | μA    | Applies to D  |
| Driver Short-Circuit Current                              |      |      |                 |       |   |
| V <sub>OUT</sub> = HIGH                                   | 35   |      | 250             | mA    | -7V ≤ V <sub>O</sub> ≤ +12V   |
| V <sub>OUT</sub> = LOW                                    | 35   |      | 250             | mA    | -7V ≤ V <sub>O</sub> ≤ +12V   |
| <b>SP490 DRIVER</b>                                       |      |      |                 |       |   |
| <b>AC Characteristics</b>                                 |      |      |                 |       |   |
| Maximum Data Rate   | 5    |      |                 | Mbps  |   |
| Driver Input to Output                                    | 20   | 30   | 60              | ns    | t <sub>PLH</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; <i>see figures 3 and 6</i>   |
| Driver Input to Output                                    | 20   | 30   | 60              | ns    | t <sub>PHL</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; <i>see figures 3 and 6</i>   |
| Driver Skew   |      | 5    |                 | ns    | <i>see figures 3 and 6</i> ,  |
| Driver Rise or Fall Time                                  | 3    | 15   | 40              | ns    | t <sub>SKREW</sub> =   t <sub>DPLH</sub> - t <sub>DPHL</sub>  <br>From 10% to 90%; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; <i>see figures 3 and 6</i> |
| <b>SP490 RECEIVER</b>                                     |      |      |                 |       |   |
| <b>DC Characteristics</b>                                 |      |      |                 |       |   |
| Differential Input Threshold                              | 0.2  |      | +0.2            | Volts | -7V ≤ V <sub>CM</sub> ≤ 12V   |
| Input Hysteresis  |      | 70   |                 | mV    | V <sub>CM</sub> = 0V  |
| Output Voltage High                                       | 3.5  |      |                 | Volts | I <sub>O</sub> = -4mA, V <sub>ID</sub> = +200mV   |
| Output Voltage Low  |      |      | 0.4             | Volts | I <sub>O</sub> = +4mA, V <sub>ID</sub> = -200mV   |
| Input Resistance  | 12   | 15   |                 | kΩ    | -7V ≤ V <sub>CM</sub> ≤ 12V   |
| Input Current (A, B); V <sub>IN</sub> = 12V               |      |      | ±1.0            | mA    | V <sub>IN</sub> = 12V   |
| Input Current (A, B); V <sub>IN</sub> = -7V               |      |      | -0.8            | mA    | V <sub>IN</sub> = -7V   |
| Short-Circuit Current                                     |      |      | 85              | mA    | 0V ≤ V <sub>O</sub> ≤ V <sub>CC</sub>   |

# SPECIFICATIONS (continued)

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

| PARAMETERS                                | MIN.  | TYP. | MAX.  | UNITS       | CONDITIONS  |
|---|-------|------|-------|-------------|---|
| <b>SP490 RECEIVER</b>                     |       |      |       |             |   |
| <b>AC Characteristics</b>                 |       |      |       |             |   |
| Maximum Data Rate                         | 5     |      |       | Mbps        |   |
| Receiver Input to Output                  | 60    | 90   | 150   | ns          | $t_{PLH}; R_{DIFF} = 54\Omega,$<br>$C_{L1} = C_{L2} = 100pF;$ Figures 3 & 8 |
| Receiver Input to Output                  | 60    | 90   | 150   | ns          | $t_{PHL}; R_{DIFF} = 54\Omega,$<br>$C_{L1} = C_{L2} = 100pF;$ Figures 3 & 8 |
| Diff. Receiver Skew $ t_{PLH} - t_{PHL} $ |       | 13   |       | ns          | $R_{DIFF} = 54\Omega; C_{L1} = C_{L2} = 100pF;$<br>Figures 3 & 8            |
| <b>POWER REQUIREMENTS</b>                 |       |      |       |             |   |
| Supply Voltage                            | +4.75 |      | +5.25 | Volts       |   |
| Supply Current                            |       | 900  |       | $\mu A$     |   |
| <b>ENVIRONMENTAL AND MECHANICAL</b>       |       |      |       |             |   |
| Operating Temperature Commercial (_C_)    | 0     |      | +70   | $^{\circ}C$ |   |
| Operating Temperature Industrial (_E_)    | -40   |      | +85   | $^{\circ}C$ |   |
| Storage Temperature                       | -65   |      | +150  | $^{\circ}C$ |   |
| Package                                   |       |      |       |             |   |
| Plastic DIP (_S_)                         |       |      |       |             |   |
| NSOIC (_N)                                |       |      |       |             |   |

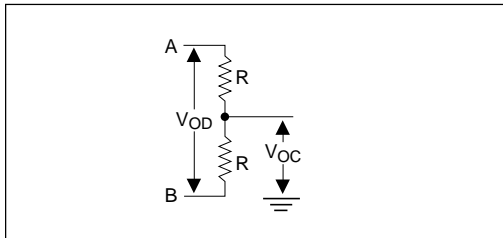


Figure 1. Driver DC Test Load Circuit

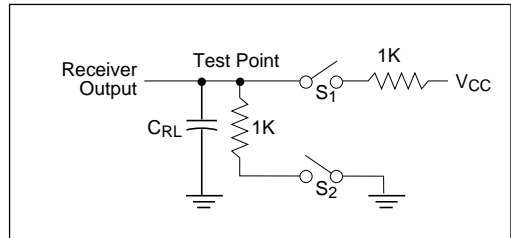


Figure 2. Receiver Timing Test Load Circuit

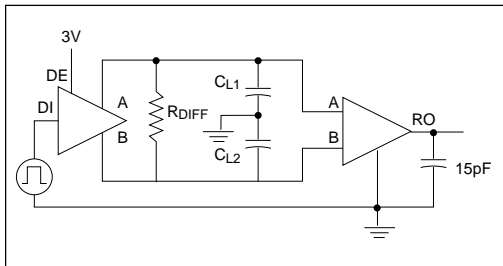


Figure 3. Driver/Receiver Timing Test Circuit

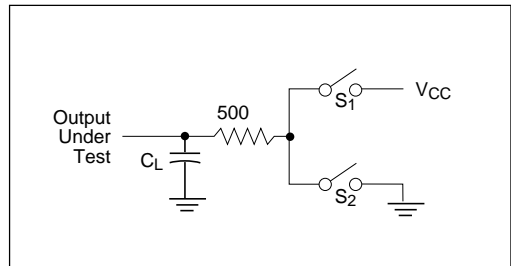


Figure 4. Driver Timing Test Load #2 Circuit

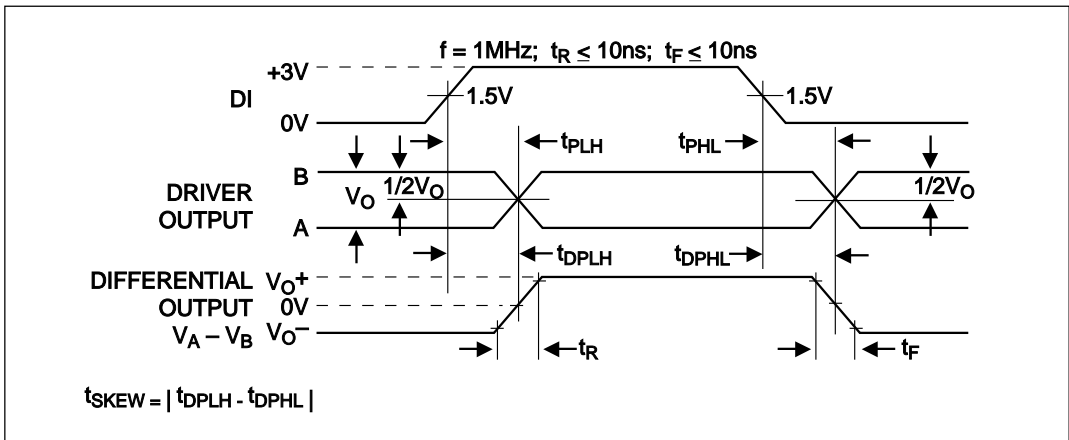


Figure 6. Driver Propagation Delays

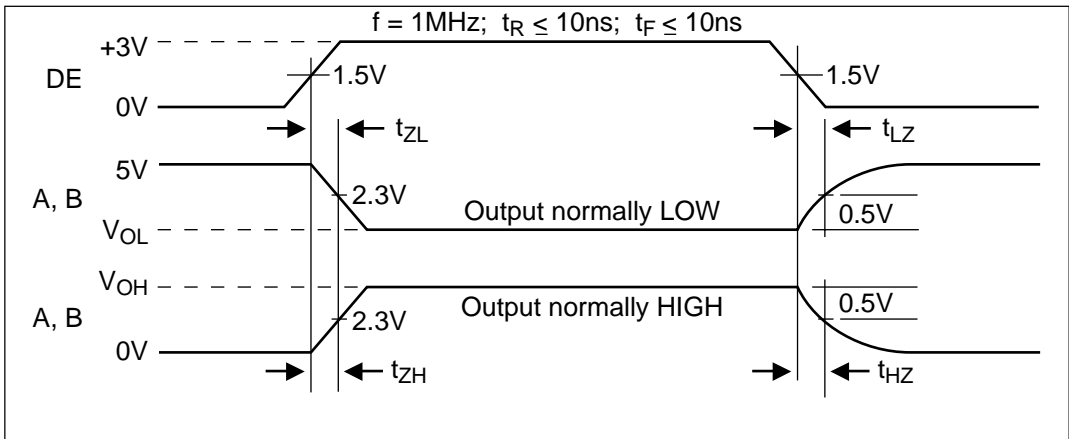


Figure 7. Driver Enable and Disable Times

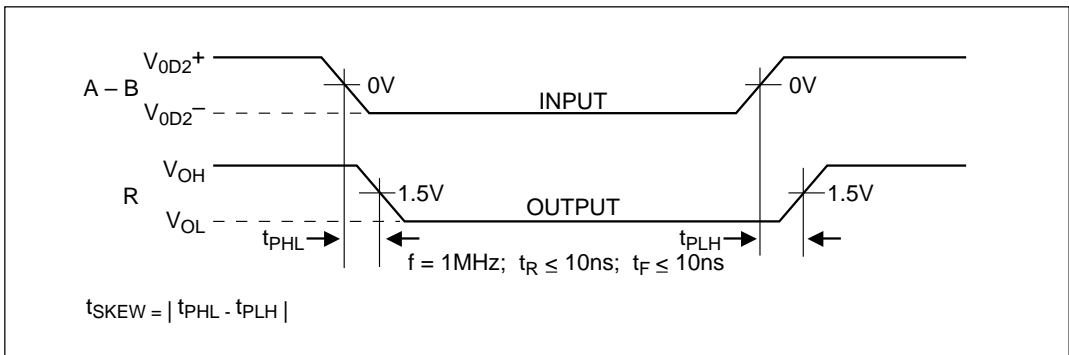


Figure 8. Receiver Propagation Delays

## 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 <sub>CC</sub> .....    | +7V                              |
| Input Voltages           |                                  |
| Logic.....               | -0.5V to (V <sub>CC</sub> +0.5V) |
| Drivers.....             | -0.5V to (V <sub>CC</sub> +0.5V) |
| Receivers.....           | ±14V                             |
| Output Voltages          |                                  |
| Logic.....               | -0.5V to (V <sub>CC</sub> +0.5V) |
| Drivers.....             | ±14V                             |
| Receivers.....           | -0.5V to (V <sub>CC</sub> +0.5V) |
| Storage Temperature..... | -65°C to +150                    |
| Power Dissipation.....   | 1000mW                           |

## SPECIFICATIONS

T<sub>MIN</sub> to T<sub>MAX</sub> and V<sub>CC</sub> = 5V ± 5% unless otherwise noted.

| PARAMETERS   | MIN. | TYP. | MAX.            | UNITS | CONDITIONS  |
|--|------|------|-----------------|-------|---|
| <b>SP491 DRIVER</b>  |      |      |                 |       |   |
| <b>DC Characteristics</b>  |      |      |                 |       |   |
| Differential Output Voltage  | GND  |      | V <sub>CC</sub> | Volts | Unloaded; R = ∞ ; see figure 1  |
| Differential Output Voltage  | 2    |      | V <sub>CC</sub> | Volts | With Load; R = 50Ω; (RS422); see figure 1   |
| Differential Output Voltage  | 1.5  |      | V <sub>CC</sub> | Volts | With Load; R = 27Ω; (RS485); see figure 1   |
| Change in Magnitude of Driver Differential Output Voltage for Complimentary States |      |      | 0.2             | Volts | R = 27Ω or R = 50Ω; see figure 1  |
| Driver Common-Mode Output Voltage  |      |      | 3               | Volts | R = 27Ω or R = 50Ω; see figure 1  |
| Input High Voltage   | 2.0  |      |                 | Volts | Applies to D, REB, DE   |
| Input Low Voltage  |      |      | 0.8             | Volts | Applies to D, REB, DE   |
| Input Current  |      |      | ±10             | μA    | Applies to D, REB, DE   |
| Driver Short-Circuit Current   |      |      |                 |       |   |
| V <sub>OUT</sub> = HIGH  | 35   |      | 250             | mA    | -7V ≤ V <sub>O</sub> ≤ 12V  |
| V <sub>OUT</sub> = LOW   | 35   |      | 250             | mA    | -7V ≤ V <sub>O</sub> ≤ 12V  |
| <b>SP491 DRIVER</b>  |      |      |                 |       |   |
| <b>AC Characteristics</b>  |      |      |                 |       |   |
| Maximum Data Rate  | 5    |      |                 | Mbps  | REB = 5V, DE = 5V   |
| Driver Input to Output   | 20   | 30   | 60              | ns    | t <sub>PLH</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 and 6  |
| Driver Input to Output   | 20   | 30   | 60              | ns    | t <sub>PHL</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 and 6  |
| Driver Skew  |      | 5    | 10              | ns    | see figures 3 and 6,  |
| Driver Rise or Fall Time   | 3    | 15   | 40              | ns    | t <sub>SKREW</sub> =  t <sub>DPLH</sub> - t <sub>DPHL</sub>  <br>From 10% to 90%; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 and 6 |
| Driver Enable to Output High   |      | 40   | 70              | ns    | C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 4 and 7; S <sub>2</sub> closed   |
| Driver Enable to Output Low  |      | 40   | 70              | ns    | C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 4 and 7; S <sub>1</sub> closed   |
| Driver Disable Time from Low   |      | 40   | 70              | ns    | C <sub>L1</sub> = C <sub>L2</sub> = 15pF; see figures 4 and 7; S <sub>1</sub> closed  |
| Driver Disable Time from High  |      | 40   | 70              | ns    | C <sub>L1</sub> = C <sub>L2</sub> = 15pF; see figures 4 and 7; S <sub>2</sub> closed  |

# SPECIFICATIONS (continued)

T<sub>MIN</sub> to T<sub>MAX</sub> and V<sub>CC</sub> = 5V ± 5% unless otherwise noted.

| PARAMETERS   | MIN.  | TYP. | MAX.  | UNITS | CONDITIONS  |
|--|-------|------|-------|-------|---|
| <b>SP491 RECEIVER</b>  |       |      |       |       |   |
| <b>DC Characteristics</b>  |       |      |       |       |   |
| Differential Input Threshold   | -0.2  |      | +0.2  | Volts | -7V ≤ V <sub>CM</sub> ≤ 12V   |
| Input Hysteresis   |       | 70   |       | mV    | V <sub>CM</sub> = 0V  |
| Output Voltage High  | 3.5   |      |       | Volts | I <sub>O</sub> = -4mA, V <sub>ID</sub> = +200mV   |
| Output Voltage Low   |       |      | 0.4   | Volts | I <sub>O</sub> = +4mA, V <sub>ID</sub> = -200mV   |
| Three State (high impedance)   |       |      |       |       |   |
| Output Current   |       |      | ±1    | μA    | 0.4V ≤ V <sub>O</sub> ≤ 2.4V; $\overline{REB} = 5V$   |
| Input Resistance   | 12    | 15   |       | kΩ    | -7V ≤ V <sub>CM</sub> ≤ 12V   |
| Input Current (A, B); V <sub>IN</sub> = 12V                          |       |      | ±1.0  | mA    | DE = 0V, V <sub>CC</sub> = 0V or 5.25V, V <sub>IN</sub> = 12V   |
| Input Current (A, B); V <sub>IN</sub> = -7V                          |       |      | -0.8  | mA    | DE = 0V, V <sub>CC</sub> = 0V or 5.25V, V <sub>IN</sub> = -7V   |
| Short-Circuit Current  | 7     |      | 85    | mA    | 0V ≤ V <sub>O</sub> ≤ V <sub>CC</sub>   |
| <b>SP491 RECEIVER</b>  |       |      |       |       |   |
| <b>DC Characteristics</b>  |       |      |       |       |   |
| Maximum Data Rate  | 5     |      |       | Mbps  | $\overline{REB} = 0V$   |
| Receiver Input to Output   | 60    | 90   | 150   | ns    | t <sub>PLH</sub> ; R <sub>DIFF</sub> = 54Ω,<br>C <sub>L1</sub> = C <sub>L2</sub> = 100pF; Figures 3 & 8 |
| Receiver Input to Output   | 60    | 90   | 150   | ns    | t <sub>PHL</sub> ; R <sub>DIFF</sub> = 54Ω,<br>C <sub>L1</sub> = C <sub>L2</sub> = 100pF; Figures 3 & 8 |
| Diff. Receiver Skew I <sub>t<sub>PLH</sub></sub> -t <sub>PHL</sub> I |       | 13   |       | ns    | R <sub>DIFF</sub> = 54Ω; C <sub>L1</sub> = C <sub>L2</sub> = 100pF;<br>Figures 3 & 8                    |
| Receiver Enable to Output Low  |       | 20   | 50    | ns    | C <sub>RL</sub> = 15pF; Figures 2 and 9; S <sub>1</sub> closed  |
| Receiver Enable to Output High                                       |       | 20   | 50    | ns    | C <sub>RL</sub> = 15pF; Figures 2 and 9; S <sub>2</sub> closed  |
| Receiver Disable from Low  |       | 20   | 50    | ns    | C <sub>RL</sub> = 15pF; Figures 2 and 9; S <sub>1</sub> closed  |
| Receiver Disable from High   |       | 20   | 50    | ns    | C <sub>RL</sub> = 15pF; Figures 2 and 9; S <sub>2</sub> closed  |
| <b>POWER REQUIREMENTS</b>  |       |      |       |       |   |
| Supply Voltage   | +4.75 |      | +5.25 | Volts |   |
| Supply Current   |       | 600  |       | μA    | $\overline{REB}$ , D = 0V or V <sub>CC</sub> ; DE = V <sub>CC</sub>                                     |
| <b>SP491 ENVIRONMENTAL AND MECHANICAL</b>                            |       |      |       |       |   |
| Operating Temperature  |       |      |       |       |   |
| Commercial (_C_)   | 0     |      | +70   | °C    |   |
| Industrial (_E_)   | -40   |      | +85   | °C    |   |
| Storage Temperature  | -65   |      | +150  | °C    |   |
| Package  |       |      |       |       |   |
| Plastic DIP (_S_)  |       |      |       |       |   |
| NSOIC (_N)   |       |      |       |       |   |

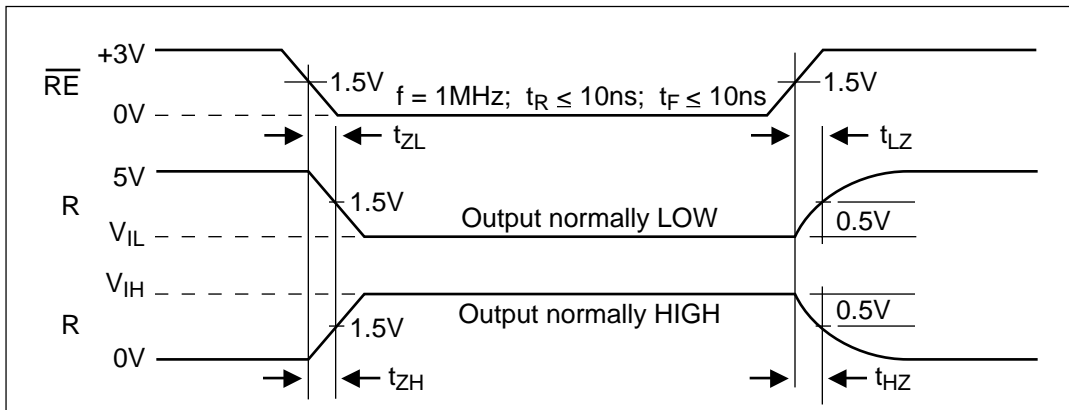


Figure 9. Receiver Enable and Disable Times

## DESCRIPTION

The **SP490** and **SP491** are full-duplex differential transceivers that meet the requirements of RS-485 and RS-422. Fabricated with a **Sipex** proprietary BiCMOS process, both products require a fraction of the power of older bipolar designs.

The RS-485 standard is ideal for multi-drop applications or for long-distance interfaces. RS-485 allows up to 32 drivers and 32 receivers to be connected to a data bus, making it an ideal choice for multi-drop applications. Since the cabling can be as long as 4,000 feet, RS-485 transceivers are equipped with a wide (-7V to +12V) common mode range to accommodate ground potential differences. Because RS-485 is a differential interface, data is virtually immune to noise in the transmission line.

### Driver...

The drivers for both the **SP490** and **SP491** have differential outputs. The typical voltage output swing with no load will be 0 volts to +5 volts. With worst case loading of  $54\Omega$  across the differential outputs, the driver can maintain greater than 1.5V voltage levels.

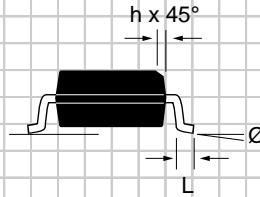
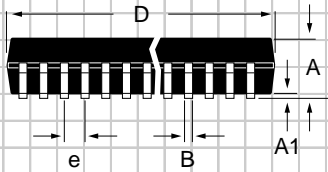
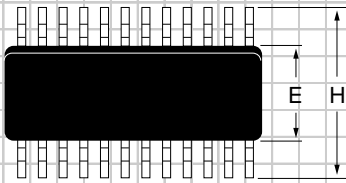
The driver of the **SP491** has a driver enable control line which is active high. A logic high on DE (pin 4) of the **SP491** will enable the differential driver outputs. A logic low on DE (pin 4) of the **SP491** will tri-state the driver outputs. The **SP490** does not have a driver enable.

### Receiver...

The receivers for both the **SP490** and **SP491** 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. The receivers for both the **SP490** and **SP491** are equipped with the fail-safe feature. Fail-safe guarantees that the receiver output will be in a high state when the input is left unconnected.

The receiver of the **SP491** has a receiver enable control line which is active low. A logic low on  $\overline{\text{REB}}$  (pin 3) of the **SP491** will enable the differential receiver. A logic high on  $\overline{\text{REB}}$  (pin 3) of the **SP491** will tri-state the receiver.

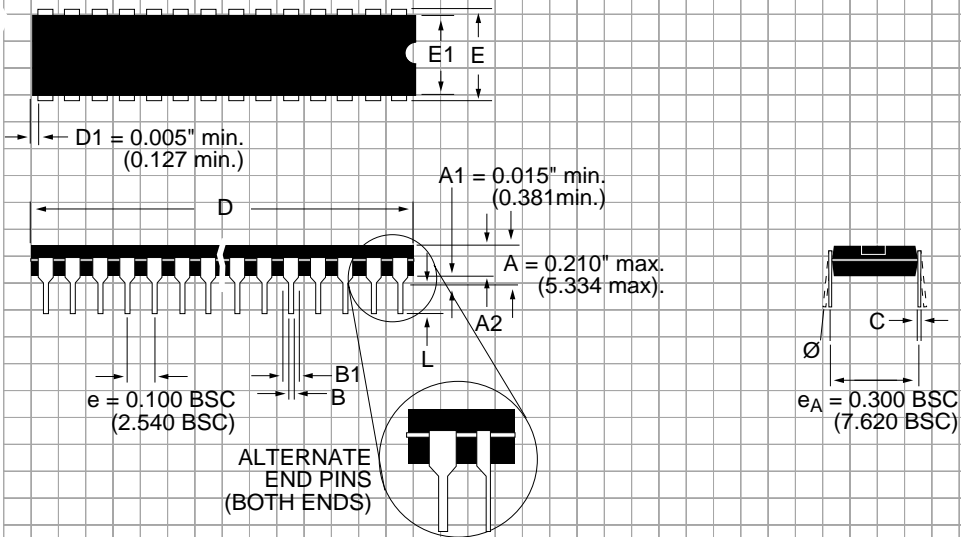
**PACKAGE: PLASTIC  
SMALL OUTLINE (SOIC)  
(NARROW)**



| 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°)             |



# 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)   |
| Ø  | 0°/ 15°<br>(0°/15°)           | 0°/ 15°<br>(0°/15°)            |

## ORDERING INFORMATION

| Model         | Temperature Range    | Package      |
|---------------|----------------------|--------------|
| SP490CN ..... | 0°C to +70°C .....   | 8-Pin NSOIC  |
| SP490CS ..... | 0°C to +70°C .....   | 8-Pin DIP    |
| SP490EN ..... | -40°C to +85°C ..... | 8-Pin NSOIC  |
| SP490ES ..... | -40°C to +85°C ..... | 8-Pin DIP    |
| SP491CN ..... | 0°C to +70°C .....   | 14-Pin NSOIC |
| SP491CS ..... | 0°C to +70°C .....   | 14-Pin DIP   |
| SP491EN ..... | -40°C to +85°C ..... | 14-Pin NSOIC |
| SP491ES ..... | -40°C to +85°C ..... | 14-Pin DIP   |

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



SIGNAL PROCESSING EXCELLENCE

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