

# SP490/491

# Full Duplex RS-485 Transceivers

## FEATURES

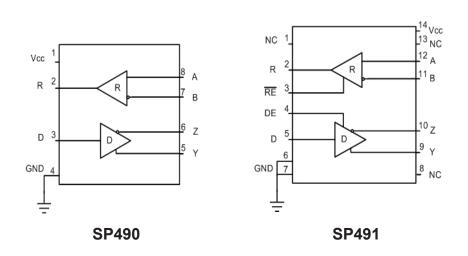
- +5V Only
- Low Power BiCMOS
- Driver/Receiver Enable (SP491)
- RS-485 and RS-422 Drivers/Receivers
- Pin Compatible with LTC490 and SN75179 (SP490)
- Pin Compatible with LTC491 and SN75180 (SP491)

Now Available in Lead Free Packaging

#### 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 ±200mV 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	+7V
V <sub>cc</sub> Input Voltages	
Drivers	0.5V to (V <sub>cc</sub> +0.5V)
Receivers	±14V
Output Voltages	
Drivers	
Receivers	0.5V to (V <sub>cc</sub> +0.5V)
Receivers Storage Temperature	65°C to +150°
Power Dissipation	

#### $T_{MIN}$ to $T_{MAX}$ and $V_{cc}$ = 5V ± 5% unless otherwise noted.

#### TYP. MAX. UNITS PARAMETERS MIN. CONDITIONS SP490 DRIVER **DC Characteristics** V<sub>cc</sub> V<sub>cc</sub> **Differential Output Voltage** GND Volts Unloaded; $R = \infty$ ; see figure 1 **Differential Output Voltage** 2 Volts With Load: $R = 50\Omega$ : (RS422): see figure 1 **Differential Output Voltage** 1.5 $V_{cc}$ Volts With Load; $R = 27\Omega$ ; (RS485); see fiaure 1 Change in Magnitude of Driver Differential Output Voltage for **Complimentary States** 0.2 Volts $R = 27\Omega$ or $R = 50\Omega$ : see figure 1 Driver Common-Mode **Output Voltage** 3 Volts $R = 27\Omega$ or $R = 50\Omega$ ; see figure 1 2.0 Volts Applies to D Input High Voltage Input Low Voltage 0.8 Volts Applies to D Input Current +10μA Applies to D Driver Short-Circuit Current $V_{OUT} = HIGH$ $V_{OUT} = LOW$ $\begin{array}{l} -7 V \leq V_{\odot} \leq +12 V \\ -7 V \leq V_{\odot} \leq +12 V \end{array}$ 250 mΑ 250 mΑ SP490 DRIVER **AC Characteristics** Maximum Data Rate 5 Mbps $t_{_{\rm PLH}};\, {\rm R}_{_{\rm DIFF}}$ = 54 $\Omega,\, {\rm C}_{_{\rm L1}}$ = ${\rm C}_{_{\rm L2}}$ = 100 pF; see figures 3 and 6 30 Driver Input to Output 60 ns $t_{PHL}$ ; $R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100 \text{pF}$ ; see figures 3 and 6 Driver Input to Output 30 60 ns Driver Skew 5 ns see figures 3 and 6. $t_{skew} = |t_{DPLH} - t_{DPHL}|$ From 10% to 90%; $R_{DIFF} = 54\Omega$ , Driver Rise or Fall Time 15 40 ns $C_{11} = C_{12} = 100 \text{pF}$ ; see figures 3 and 6 SP490 RECEIVER **DC Characteristics** $-7V \le V_{CM} \le 12V$ $V_{CM} = 0V$ Differential Input Threshold -02 +0.2Volts $V_{CM} = 0V$ $I_{0} = -4mA, V_{1D} = +200mV$ $I_{0} = +4mA, V_{1D} = -200mV$ $-7V \le V_{CM} \le 12V$ $V_{1N} = 12V$ Input Hysteresis 70 mV 3.5 Volts Output Voltage High Output Voltage Low 0.4 Volts Input Resistance 12 15 kΩ Input Current (A, B); V<sub>IN</sub> = 12V ±1.0 mΑ $V_{IN}^{IN} = -7V$ $0V \le V_{O} \le V_{CC}$ Input Current (A, B); V<sub>IN</sub> = -7V -0.8 mΑ Short-Circuit Current 85 mΑ

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**ELECTRICAL CHARACTERISTICS** 

# **ELECTRICAL CHARACTERISTICS**

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP490 RECEIVER					
AC Characteristics					
Maximum Data Rate	5			Mbps	
Receiver Input to Output	Ĭ	45	150	ns	t : R = 540
			100	113	$t_{PLH}; R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100 \text{pF}; Figures 3 \& 8$
Receiver Input to Output		45	150	ns	$t^{11} R^{2} = 540$
		10	100	110	$t_{PHL}^{L1}; R_{DIFF}^{L2} = 54\Omega, C_{L1}^{L1} = C_{L2}^{-1} 100 \text{ pF}; Figures 3 \& 8$
Diff. Receiver Skew It <sub>PLH</sub> -t <sub>PHL</sub> I		13		ns	$R_{DIFF}^{L1} = 54\Omega; C_{L1} = C_{L2} = 100 pF;$
PLH PHL					Figures 3 & 8
POWER REQUIREMENTS					
Supply Voltage	+4.75		+5.25	Volts	
Supply Current		900		μA	
				T.	
ENVIRONMENTAL AND					
MECHANICAL					
Operating Temperature					
Commercial (C_)	0		+70	°C	
Industrial (E_)	-40		+85	°C	
Storage Temperature	-65		+150	°C	
Package					
Plastic DIP (_S)			1		
NSOIC ( N)					

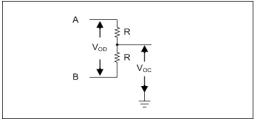
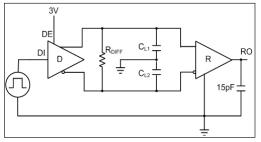


Figure 1. Driver DC Test Load Circuit





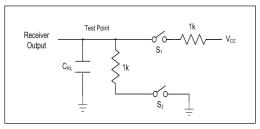
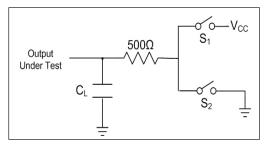
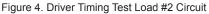


Figure 2. Receiver Timing Test Load Circuit





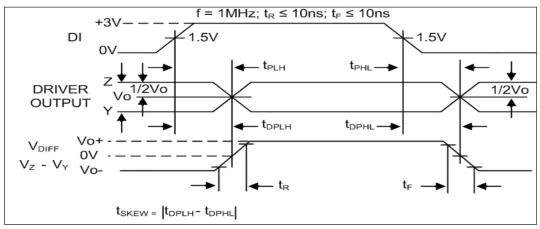


Figure 6. Driver Propagation Delays

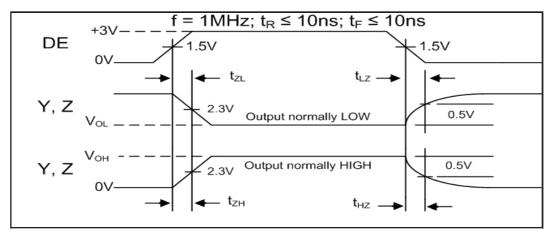


Figure 7. Driver Enable and Disable Times

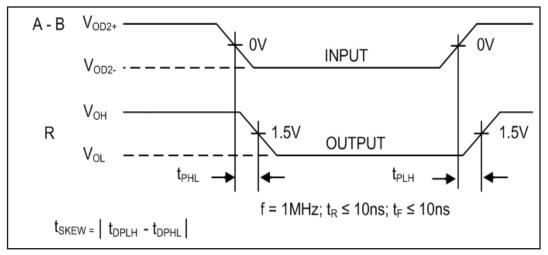


Figure 8. Receiver Propagation Delays

#### ABSOLUTE MAXIMUM RATINGS These are stress ratings only and functional operation of the device

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		+7V
Input Volta	ges	
	Logic	0.5V to (V <sub>cc</sub> +0.5V)
	Drivers	-0.5V to (V <sub>cc</sub> +0.5V)
	Receivers	±14V
Output Vol	tages	
	Logic	0.5V to (V <sub>cc</sub> +0.5V)
	Drivers	±14V
	Receivers	0.5V to (V <sub>cc</sub> +0.5V)
Storage Te	mperature	65°C to +150
		1000mW

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

$I_{MIN}$ to $I_{MAX}$ and $V_{cc} = 5V \pm 5\%$ unless otherw <b>PARAMETERS</b>	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP491 DRIVER	WILLY.	116.		JUNITS	CONDITIONS
DC Characteristics					
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);
			00		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			0.0	Valta	D = 270  or  D = 5000  on  figure 1
Driver Common-Mode			0.2	Volts	$R = 27\Omega$ or $R = 50\Omega$ ; see figure 1
Output Voltage			3	Volts	R = $27\Omega$ or R = $50\Omega$ ; see figure 1
Input High Voltage	2.0			Volts	Applies to D, $\overline{\text{REB}}$ , DE
Input Low Voltage	2.0		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			250	mA	-7V ≤ V <sub>0</sub> ≤ 12V
V <sub>OUT</sub> = LOW			250	mA	$-7V \le V_0^{\circ} \le 12V$
SP491 DRIVER					
AC Characteristics					
Maximum Data Rate	5			Mbps	REB = 5V. DE = 5V
Driver Input to Output		30	60	ns	
					$t_{PLH}$ ; $R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100 pF$ ; see figures 3 and 6
Driver Input to Output		30	60	ns	$t_{pull}; R_{pull} = 54\Omega, C_{14} = C_{12} = 100 pF;$
					$t_{PHL}$ ; $R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100 pF$ ; see figures 3 and 6
Driver Skew		5	10	ns	see figures 3 and 6,
		4-			$t_{\text{SKEW}} =  t_{\text{DPLH}} - t_{\text{DPHL}} $
Driver Rise or Fall Time		15	40	ns	From 10% to 90%; $R_{DIEE} = 54\Omega$ ,
Driver Enable to Output Llich		40	70	20	$C_{L1} = C_{L2} = 100 \text{pF}; see figures 3 and 6$
Driver Enable to Output High		40	/0	ns	$C_{L1} = C_{L2} = 100 \text{pF}$ ; see figures $C_{L1} = C_{L2} = 100 \text{pF}$ ; see figures 4  and  7; S <sub>2</sub> closed $C_{L1} = C_{L2} = 100 \text{pF}$ ; see figures $C_{L1} = C_{L2} = 100 \text{pF}$ ; see figures
Driver Enable to Output Low		40	70	ns	$C_{1} = C_{2} = 100 \text{ nE}^{\circ}$ see figures
		70	10	113	4 and / S closed
Driver Disable Time from Low		40	70	ns	$C_{1,2} = C_{1,2} = 100 \text{pF}; see figures$
		-	-		4 and 7; S, closed
Driver Disable Time from High		40	70	ns	$C_{11} = C_{12} = 100 \text{pF}$ ; see figures
-					$C_{L1} = C_{L2} = 100 \text{pF}; \text{ see figures}$ 4 and 7; S <sub>1</sub> closed $C_{L1} = C_{L2} = 100 \text{pF}; \text{ see figures}$ 4 and 7; S <sub>2</sub> closed

#### - ELECTRICAL CHARACTERISTICS

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$_{\text{IN}}$ to T <sub>max</sub> and V <sub>cc</sub> = 5V ± 5% unless otherwise noted.					
	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP491 RECEIVER DC Characteristics Differential Input Threshold Input Hysteresis Output Voltage High Output Voltage Low	-0.2 3.5	70	+0.2	Volts mV Volts Volts	$-7V \le V_{CM} \le 12V$ $V_{CM} = 0V$ $I_{O} = -4mA, V_{ID} = +200mV$ $I_{O} = +4mA, V_{ID} = -200mV$
Three State (high impedance) Output Current Input Resistance Input Current (A, B); $V_{IN} = 12V$ Input Current (A, B); $V_{IN} = -7V$ Short-Circuit Current	12	15	±1 ±1.0 -0.8 85	μA kΩ mA mA mA	$\begin{array}{l} 0.4V \leq V_{o} \leq 2.4V; \ \overline{REB} = 5V \\ -7V \leq V_{\rm CM} \leq 12V \\ DE = 0V, V_{\rm CC} = 0V \ \text{or} \ 5.25V, \ V_{\rm IN} = 12V \\ DE = 0V, \ V_{\rm CC} = 0V \ \text{or} \ 5.25V, \ V_{\rm IN} = -7V \\ 0V \leq V_{o} \leq V_{\rm CC} \end{array}$
SP491 RECEIVER AC Characteristics Maximum Data Rate Receiver Input to Output	5 20	45	150	Mbps ns	$\overline{\text{REB}}$ = 0V t <sub>PLH</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; Figures 3 & 8
Receiver Input to Output Diff. Receiver Skew It <sub>PLH</sub> -t <sub>PHL</sub> I	20	45 13	150	ns ns	$t_{PHL}; R_{DIFF} = 54\Omega,$ $C_{L1} = C_{L2} = 100 pF;$ Figures 3 & 8 $R_{DIFF} = 54\Omega; C_{L1} = C_{L2} = 100 pF;$
Receiver Enable to Output Low Receiver Enable to Output High Receiver Disable from Low Receiver Disable from High		45 45 45 45	70 70 70 70	ns ns ns ns	Figures 3 & 8 $C_{RL}$ = 15pF; Figures 2 and 9; S, closed $C_{RL}$ = 15pF; Figures 2 and 9; S <sub>2</sub> closed $C_{RL}$ = 15pF; Figures 2 and 9; S <sub>1</sub> closed $C_{RL}$ = 15pF; Figures 2 and 9; S <sub>2</sub> closed
POWER REQUIREMENTS Supply Voltage Supply Current	+4.75	900	+5.25	Volts μA	$\overline{\text{REB}}$ , D = 0V or V <sub>cc</sub> ; DE = V <sub>cc</sub>
SP491 ENVIRONMENTAL AND MECHANICAL Operating Temperature Commercial (C_) Industrial (E_) Storage Temperature Package Plastic DIP (_S) NSOIC (_N)	0 -40 -65		+70 +85 +150	သံသိ	

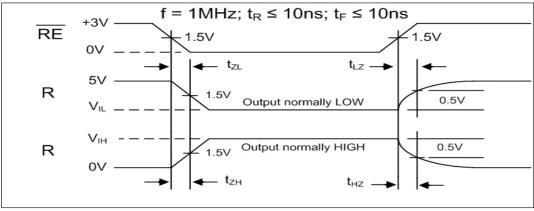


Figure 9. Receiver Enable and Disable Times

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#### 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...

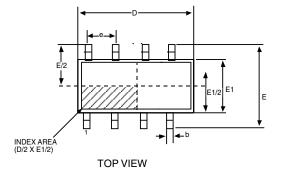
The drivers for both the **SP490** and **SP491** have differential outputs. The typical voltage output swing with no load will be 0 volts to +5 volts. With worst case loading of  $54\Omega$  across the differential outputs, the driver can maintain greater than 1.5V voltage levels.

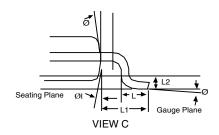
The driver of the **SP491** has a driver enable control line which is active high. A logic high on DE (pin 4) of the **SP491** will enable the differential driver outputs. A logic low on DE (pin 4) of the **SP491** will tri-state the driver outputs. The **SP490** does not have a driver enable.

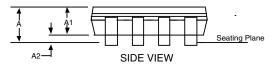
### Receiver...

The receivers for both the **SP490** and **SP491** have differential inputs with an input sensitivity as low as  $\pm 200$ mV. Input impedance of the receivers is typically  $15k\Omega$  ( $12k\Omega$  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. Alogic low on REB (pin 3) of the **SP491** will enable the differential receiver. A logic high on REB (pin 3) of the **SP491** will tri-state the receiver.



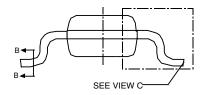


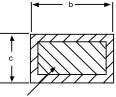


8 Pin NSOIC JEDEC MO-012 (AA) Variation				
SYMBOL	MIN	NOM	MAX	
A	1.35	-	1.75	
A1	0.1	-	0.25	
A2	1.25	-	1.65	
b	0.31	-	0.51	
С	0.17	-	0.24	
D	4.90 BSC			
E	6.00 BSC			
E1	3.90 BSC			
e	1.27 BSC			
L	0.4	-	1.27	
L1	1.04 REF			
L2	0.25 BSC			
ø	00	-	80	
ø1	5٥	-	15°	

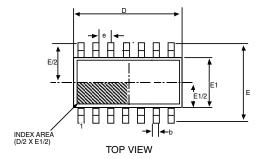
Note: Dimensions in (mm)

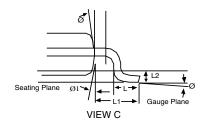
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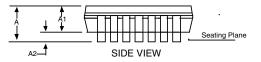




BASE METAL SECTION B-B WITH PLATING

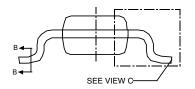


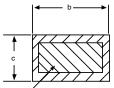




14 Pin NSOIC JEDEC MO-012 (AB) Variation				
SYMBOL	MIN	NOM	MAX	
Α	1.35	-	1.75	
A1	0.1	-	0.25	
A2	1.25	-	1.65	
b	0.31	-	0.51	
с	0.17	-	0.25	
D		8.65 BSC		
E	6.00 BSC			
E1	3.90 BSC			
е	1.27 BSC			
L	0.4	-	1.27	
L1		1.04 REF		
L2		0.25 BSC		
ø	00	-	80	
ø1	50	-	15°	

Note: Dimensions in (mm)





BASE METAL SECTION B-B WITH PLATING

#### **ORDERING INFORMATION**

Model	Temperature Range	Package
SP490CN-L	0°C to +70°C	
SP490CN-L/TR	0°C to +70°C	
SP490EN-L	-40°C to +85°C	
SP490EN=L/TR	-40°C to +85°C	
SP491CN-L	0°C to +70°C	
SP491CN/TR-L	0°C to +70°C	
SP491EN-L	-40°C to +85°C	
SP491EN-L/TR	-40°C to +85°C	

/TR = Tape and Reel Pack quantity is 2500 for NSOIC.

#### **REVISION HISTORY**

Date	Revision	Description				
02/24/05	-	Sipex Legacy Data Sheet				
07/14/08	1.0.0	Convert to Exar format.				
June 2011	1.0.1	Remove minimum entry to Driver Short Circuit Current. Change SP490 receiver propagation typical to 45ns. Remove SP491 receiver short circuit current minimum entry. Change SP491 receiver propagation delay MIN and TYP levels to 20 and 45ns respectively. Change SP491 receiver Enable and Disable time TYP and MAX levels to 45 and 70ns respectively. Change SP491 Supply Current TYP to 900µA. Remove SP491 driver rise/fall time minimum. Update ordering information.				

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