**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)
	±14V
Output Voltages	
	±14V
Receivers	0.5V to (V <sub>CC</sub> +0.5V)
Storage Temperature	65°C to +150°
Power Dissipation	1000mW

# **ELECTRICAL CHARACTERISTICS**

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

MIN.	TYP.	MAX.	UNITS	CONDITIONS
GND 2		V <sub>cc</sub>	Volts Volts	Unloaded; $R = \infty$ ; see figure 1 With Load; $R = 50\Omega$ ; (RS422);
1.5		V <sub>cc</sub>	Volts	see figure 1 With Load; R = 27Ω; (RS485); see figure 1
		0.2	Volts	R = 27Ω or R = 50Ω; see figure 1 R = 27Ω or R = 50Ω; see figure 1
2.0		0.8 ±10	Volts Volts Volts µA	Applies to D Applies to D Applies to D
		250 250	mA mA	-7V ≤ V <sub>o</sub> ≤ +12V -7V ≤ V <sub>o</sub> ≤ +12V
5	30	60	Mbps ns	$t_{\rm PLH}$ ; $R_{\rm DIFF}$ = 54 $\Omega$ , $C_{\rm L1}$ = $C_{\rm L2}$ = 100pF; see figures 3 and 6
	30	60	ns	see figures 3 and 6 $t_{PHL}$ ; $R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; see figures 3 and 6
	5		ns	see figures 3 and 6,
	15	40	ns	$ \begin{array}{l} \textbf{t}_{\text{SKEW}} =  ~\textbf{t}_{\text{DPLH}} - \textbf{t}_{\text{DPHL}}  \\ \text{From 10\% to 90\%; R}_{\text{DIFF}} = 54\Omega, \\ \textbf{C}_{\text{L1}} = \textbf{C}_{\text{L2}} = 100\text{pF; see figures 3 and 6} \end{array} $
-0.2 3.5 12	70 15	+0.2 0.4 ±1.0 -0.8 85	Volts mV Volts Volts kΩ mA mA mA	$ \begin{array}{l} -7 \text{V} \leq \text{V}_{\text{CM}} \leq 12 \text{V} \\ \text{V}_{\text{C}} = 0 \text{V} \\ \text{I}_{\text{O}} = -4 \text{mA}, \text{V}_{\text{ID}} = +200 \text{mV} \\ \text{I}_{\text{O}} = +4 \text{mA}, \text{V}_{\text{ID}} = -200 \text{mV} \\ -7 \text{V} \leq \text{V}_{\text{CM}} \leq 12 \text{V} \\ \text{V}_{\text{IN}} = 12 \text{V} \\ \text{V}_{\text{IN}} = -7 \text{V} \\ 0 \text{V} \leq \text{V}_{\text{O}} \leq \text{V}_{\text{CC}} \end{array} $
	GND 2 1.5 2.0 5	GND 2 1.5 2.0 5 30 30 5 15 15 70 3.5	GND 2 V <sub>cc</sub> V <sub>cc</sub> 1.5 V <sub>cc</sub> 1.5 V <sub>cc</sub> 0.2 3 0.8 ±10 250 250 250 5 15 40 -0.2 70 3.5 12 15 ±1.0 -0.8	GND 2 V <sub>cc</sub> Volts Volts Volts Volts Volts  1.5 V <sub>cc</sub> Volts  0.2 Volts  3 Volts Volts Volts Volts Volts Volts Volts Volts volts ±10 μA  250 mA  250 mA  250 mA  250 ns  15 40 ns  -0.2 70  3.5 15 0.4 Volts MΩ  ±1.0 mA  -0.8 mA

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP490 RECEIVER					
AC Characteristics					
Maximum Data Rate	5			Mbps	
Receiver Input to Output		45	150	ns ·	$t_{\text{out}}$ ; $R_{\text{out}} = 54\Omega$ ,
·					$t_{PLH}$ ; $R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100 pF$ ; Figures 3 & 8
Receiver Input to Output		45	150	ns	$t_{\text{BH}}^{\text{LI}}; R_{\text{DIFF}}^{\text{LZ}} = 54\Omega,$
					$C_{11}^{11} = C_{12}^{11} = 100 \text{pF}$ ; Figures 3 & 8
Diff. Receiver Skew It <sub>PLH</sub> -t <sub>PHI</sub> I		13		ns	$ \begin{array}{l} t_{\rm DHL}^{\rm LI}; R_{\rm DIFF}^{\rm LI} = 54\Omega, \\ C_{\rm L1} = C_{\rm L2}^{\rm L2} = 100 {\rm pF}; \ \emph{Figures 3 \& 8} \\ R_{\rm DIFF} = 54\Omega; \ C_{\rm L1} = C_{\rm L2} = 100 {\rm pF}; \end{array} $
					Figures 3 & 8
POWER REQUIREMENTS					
Supply Voltage	+4.75		+5.25	Volts	
Supply Current		900		μA	
,					
ENVIRONMENTAL AND					
MECHANICAL					
Operating Temperature					
Commercial (C_)	0		+70	°C	
Industrial (E_)	-40		+85	°C	
Storage Temperature	-65		+150	°C	
Package					
Plastic DIP (_S)					
NSOIC (_N)					

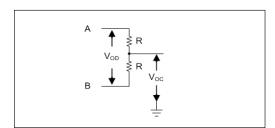


Figure 1. Driver DC Test Load Circuit

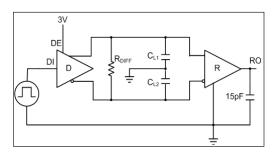


Figure 3. Driver/Receiver Timing Test Circuit

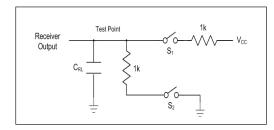


Figure 2. Receiver Timing Test Load Circuit

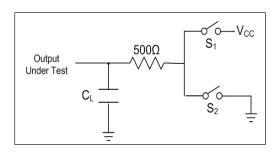


Figure 4. Driver Timing Test Load #2 Circuit

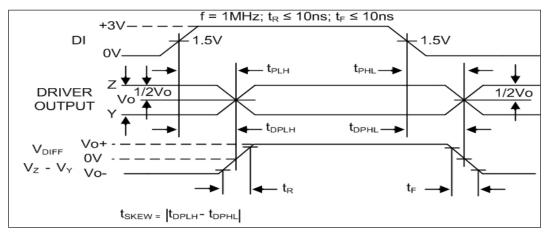


Figure 6. Driver Propagation Delays

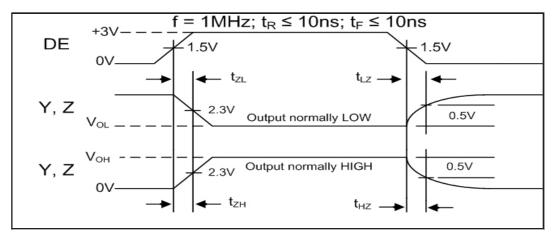


Figure 7. Driver Enable and Disable Times

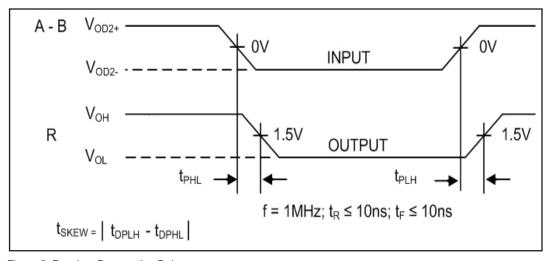


Figure 8. Receiver Propagation Delays

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)
	0.5V to (V = +0.5V)
Receivers	±14V
Output Voltages	
Logic	0.5V to (V <sub>cc</sub> +0.5V)
	±14V
Receivers	0.5V to (V <sub>cc</sub> +0.5V)
Storage Temperature	
Power Dissipation	

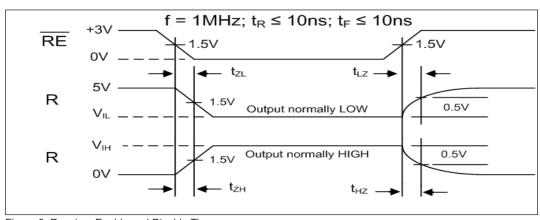
# **ELECTRICAL CHARACTERISTICS**

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP491 DRIVER					
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; $R = 50\Omega$ ; (RS422);
Differential Output Valters	1,5			1/0140	see figure 1
Differential Output Voltage figure 1	1.5		V <sub>cc</sub>	Volts	With Load; R = $27\Omega$ ; (RS485); see
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			0.2	10.10	
Output Voltage			3	Volts	$R = 27\Omega$ or $R = 50\Omega$ ; 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	μΑ	Applies to D, REB, DE
Driver Short-Circuit Current					
V <sub>OUT</sub> = HIGH			250	mA	-7V ≤ V <sub>o</sub> ≤ 12V
$V_{OUT} = LOW$			250	mA	-7V ≤ V <sub>o</sub> ≤ 12V
SP491 DRIVER					
AC Characteristics					
Maximum Data Rate	5			Mbps	REB = 5V, DE = 5V
Driver Input to Output		30	60	ns	
					$t_{PLH}$ ; $R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; see figures 3 and 6
Driver Input to Output		30	60	ns	$t_{PHL}$ ; $R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; see figures 3 and 6
					see figures 3 and 6
Driver Skew		5	10	ns	see figures 3 and 6,
5. 5. 5. 5. T		1			$t_{\text{SKEW}} =  t_{\text{DPLH}} - t_{\text{DPHL}} $
Driver Rise or Fall Time		15	40	ns	From 10% to 90%; $R_{\text{aug}} = 54\Omega$ .
Driver Enable to Output Liich		40	70	200	$C_{L1} = C_{L2} = 100 pF$ ; see figures 3 and $C_{L1} = C_{L2} = 100 pF$ ; see figures
Driver Enable to Output High		40	70	ns	$O_{L1} - O_{L2} = 100 \text{pr}$ , see lightes
Driver Enable to Output Low		40	70	ns	$4 \text{ and } 7$ ; $S_2$ closed $C_1 = C_2 = 100 \text{ pF}$ ; see figures
Divor Enable to Output Low		70	'0	113	$C_{L1} = C_{L2} = 100 \text{pF}$ ; see figures 4 and 7; $S_1$ closed
Driver Disable Time from Low		40	70	ns	$C_{1.4} = C_{1.9} = 100$ pF: see figures
					$C_{L1} = C_{L2} = 100 \text{pF}$ ; see figures 4 and 7; $S_1$ closed
Driver Disable Time from High		40	70	ns	$C_{14} = C_{15} = 100 pF$ ; see figures
_					4 and 7; S <sub>2</sub> closed
					_

 $T_{\text{min}}$  to  $T_{\text{max}}$  and  $V_{\text{cc}}$  = 5V ± 5% unless otherwise noted.

MIN TO I MAX and V <sub>CC</sub> = 5V ± 5% unless otherwise noted.					
PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP491 RECEIVER DC Characteristics Differential Input Threshold Input Hysteresis	-0.2	70	+0.2	Volts mV	-7V ≤ V <sub>CM</sub> ≤ 12V V <sub>CM</sub> = 0V
Output Voltage High Output Voltage Low Three State (high impedance)	3.5		0.4	Volts Volts	$I_0 = -4\text{mA}, V_{1D} = +200\text{mV}$ $I_0 = +4\text{mA}, V_{1D} = -200\text{mV}$
Output Current Input Resistance	12	15	±1 ±1.0	μA kΩ mA	$0.4V \le V_0 \le 2.4V; \overline{REB} = 5V$ $-7V \le V_{CM} \le 12V$
Input Current (A, B); V <sub>IN</sub> = 12V Input Current (A, B); V <sub>IN</sub> = -7V Short-Circuit Current			-0.8 85	mA mA	DE = $0V_{,\text{V}}^{\text{N}}V_{\text{CC}} = 0V \text{ or } 5.25V, V_{ \text{N}} = 12V$ DE = $0V, V_{ \text{CC}} = 0V \text{ or } 5.25V, V_{ \text{N}} = -7V$ $0V \le V_{ \text{O}} \le V_{ \text{CC}}$
SP491 RECEIVER AC Characteristics					
Maximum Data Rate	5			Mbps	REB = 0V
Receiver Input to Output	20	45	150	ns	$t_{PLH}$ ; $R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 8
Receiver Input to Output	20	45	150	ns	$t_{PHL}$ ; $R_{DIFF} = 54\Omega$ , $C_{14} = C_{12} = 100pF$ ; Figures 3 & 8
Diff. Receiver Skew It <sub>PLH</sub> -t <sub>PHL</sub> I		13		ns	$R_{DIFF}^{L1} = 54\Omega; C_{L1} = C_{L2} = 100pF;$ Figures 3 & 8
Receiver Enable to Output Low		45	70	ns	C <sub>RL</sub> = 15pF; Figures 2 and 9; S <sub>1</sub> closed
Receiver Enable to Output High Receiver Disable from Low		45 45	70 70	ns ns	C <sub>RL</sub> = 15pF; Figures 2 and 9; S <sub>2</sub> closed C <sub>RL</sub> = 15pF; Figures 2 and 9; S <sub>1</sub> closed
Receiver Disable from High		45	70	ns	$C_{RL} = 15pF$ ; Figures 2 and 9; $S_2$ closed
POWER REQUIREMENTS Supply Voltage	+4.75		+5.25	Volts	
Supply Current	14.75	900	10.20	μA	$\overline{\text{REB}}$ , D = 0V or $V_{\text{cc}}$ ; DE = $V_{\text{cc}}$
SP491 ENVIRONMENTAL AND MECHANICAL				<b>I</b>	
Operating Temperature Commercial (C)	0		+70	°C	
Industrial (E )	-40		+85	°C	
Storage Temperature	-65		+150	°Č	
Package					
Plastic DIP (_S) NSOIC ( N)					



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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...

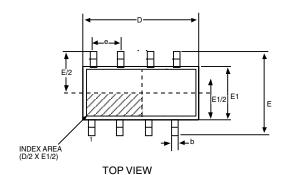
The drivers for both the **SP490** and **SP491** have differential outputs. The typical voltage output swing with no load will be 0 volts to +5 volts. With worst case loading of  $54\Omega$  across the differential outputs, the driver can maintain greater than 1.5V voltage levels.

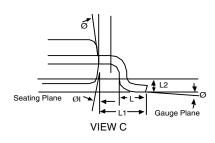
The driver of the **SP491** has a driver enable control line which is active high. A logic high on DE (pin 4) of the **SP491** will enable the differential driver outputs. A logic low on DE (pin 4) of the **SP491** will tri-state the driver outputs. The **SP490** does not have a driver enable.

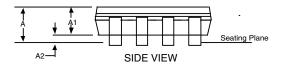
# Receiver...

The receivers for both the **SP490** and **SP491** have differential inputs with an input sensitivity as low as  $\pm 200$  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. A logic 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.

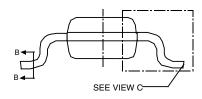


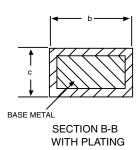


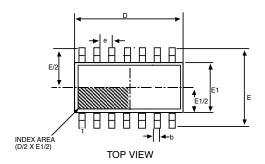


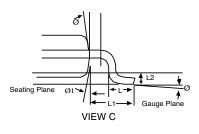
8 Pin NSOIC JEDEC MO-012 (AA) Variation				
SYMBOL	MIN	NOM	MAX	
Α	1.35	-	1.75	
A1	0.1	-	0.25	
A2	1.25	-	1.65	
b	0.31	-	0.51	
С	0.17	-	0.24	
D	4.90 BSC			
E	6.00 BSC			
E1	3.90 BSC			
е		1.27 BSC		
L	0.4	-	1.27	
L1	1.04 REF			
L2	0.25 BSC			
Ø	00	-	80	
ø1	50	-	15º	

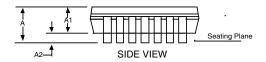






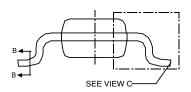


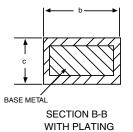




14 Pin NSOIC JEDEC MO-012 (AB) Variation				
SYMBOL	MIN	NOM	MAX	
Α	1.35	-	1.75	
A1	0.1	-	0.25	
A2	1.25	-	1.65	
b	0.31	-	0.51	
С	0.17	-	0.25	
D	8.65 BSC			
E	6.00 BSC			
E1	3.90 BSC			
е		1.27 BSC		
Ĺ	0.4	-	1.27	
L1		1.04 REF		
L2		0.25 BSC		
ø	00	-	80	
ø1	50	-	15º	







#### ORDERING INFORMATION

Model	Temperature Range	Package
SP490CN-L	0°C to +70°C	8-Pin NSOIC
SP490CN-L/TR	0°C to +70°C	8-Pin NSOIC
SP490EN-L	40°C to +85°C	8-Pin NSOIC
SP490EN=L/TR	-40°C to +85°C	8-Pin NSOIC
SP491CN-L	0°C to +70°C	14-Pin NSOIC
SP491CN/TR-L	0°C to +70°C	14-Pin NSOIC
SP491EN-L	40°C to +85°C	14-Pin NSOIC
SP491EN-L/TR	40°C to +85°C	14-Pin NSOIC

/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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