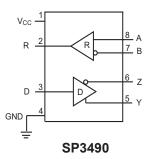


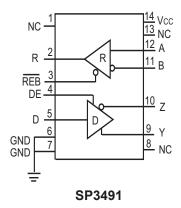
+3.3V Low Power Full-Duplex RS-485 Transceivers with 10Mbps Data Rate

- 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
- +/-200mV Receiver Input Sensitivity
- Allows up to 32 transceivers on the serial bus
- Compatability with LTC490 and SN75179 (SP3490)
- Compatability with LTC491 and SN75180 (SP3491)



DESCRIPTION

The **SP3490** and **SP3491** devices 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 **Exar** SP490 and SP491 devices as well as popular industry standards. The **SP3490** and **SP3491** feature **Exar's** BiCMOS process, allowing low power operation without sacrificing performance. The **SP3490** and **SP3491** meet the electrical specifications of the 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 reciveiver 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}	+6.0V
Input Voltages	
Logic0.:	3V to +6.0V
Drivers0.:	3V to +6.0V
Receivers	+/-14V
Output Voltages	
Drivers	+/-14V
Receivers0.3	3V to +6.0V
Storage Temperature65°C	
Power Dissipation	
8-pin NSOIC	600mW
(derate 6.90mW/°C above +70°C)	
14-pin NSOIC	700mW
(derate 8.33mW/°C above +70°C)	



$T_{ANS} = T_{ANS}$ to T_{ANS} and $V_{CC} = +3.3V + /-5\%$ unless otherwise noted.

ELECTRICAL CHARACTERISTICS

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP3490 DRIVER					
DC Characteristics					
Differential Output Voltage	GND		Vcc	Volts	Unloaded; R = ∞Ω ; Figure 1
Differential Output Voltage	2		Vcc	Volts	With Load; R = 50Ω (RS-422); Figure 1
Differential Output Voltage	1.5		Vcc	Volts	With Load; R = 27Ω (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 = 27Ω or R = 50Ω ; Figure 1
Input High Voltage	2.0			Volts	
Input Low Voltage			0.8	Volts	
Input Current			+/-10	μΑ	
Driver Short Circuit Current					
V _{OUT} = HIGH			+/-250	mA	-7V ≤ V _o ≤ +12V; Figure 8
V _{OUT} = LOW			+/-250	mA	-7V ≤ V _o ≤ +12V; Figure 8
SP3490 DRIVER					
AC Characteristics					
Max. Transmission Rate	10			Mbps	
Driver Input to Output, t _{PLH}	20	40	60	ns	R = 27Ω, Figures 2 & 9
Driver Input to Output, t _{PHL}	20	40	60	ns	R = 27Ω, Figures 2 & 9
Differential Driver Skew		2		ns	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
Driver Rise or Fall Time		5	20	ns	From 10%-90%; Figures 3 and 10

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

$I_{AMB} = I_{MIN}$ to I_{MAX} and $V_{CC} = +3.3V$ +/-5% un	1			1	
PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP3490 RECEIVER					
DC Characteristics					
Differential Input Threshold	-0.2		+0.2	Volts	-7V ≤ V _{CM} ≤ +12V
Input Hysteresis		25		mV	V _{CM} = 0V
Output Voltage HIGH	Vcc-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		kΩ	-7V ≤ V _{CM} ≤ +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 ≤ V _o ≤ V _{cc}
SP3490 RECEIVER					
AC Characteristics					
Max. Transmission Rate	10			Mbps	
Receiver Input to Output, t _{PLH}	40	70	120	ns	Figures 6 and 12
Receiver Input to Output, $\mathbf{t}_{\mathrm{PLH}}$			85	ns	T _{AMB} = +25°C, Vcc = 3.3V Figures 6 and 12
Receiver Input to Output, t _{PHL}	40	70	120	ns	Figures 6 and 12
Receiver Input to Output, $t_{\tiny PHL}$			85	ns	T_{AMB} = +25°C, Vcc = 3.3V Figures 6 and 12
Differential Receiver Skew		4		ns	$\begin{array}{c c} t_{_{PHL}}(A)\text{-}\ t_{_{PLH}}(A) ,\ t_{_{PHL}}(B)\text{-}\ t_{_{PLH}}(B) ,\\ \text{Figures 6 and 12} \end{array}$
POWER REQUIREMENTS					
Supply Voltage	3.0	3.3	3.6	V	
Supply Current		1000	2000	μΑ	D = 0V or V _{cc}
ESD Protection for D, R, A, B, Y and Z pins		+/-2		kV	Human Body Model

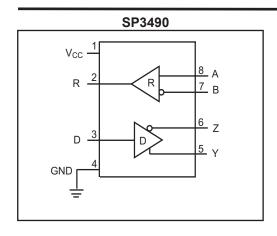
 $T_{AMB} = T_{MIN}$ to T_{MAX} and $V_{CC} = +3.3V + /-5\%$ unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP3491 DRIVER					
DC Characteristics					
Differential Output Voltage	GND		Vcc	Volts	Unloaded; R = ∞Ω ; Figure 1
Differential Output Voltage	2		Vcc	Volts	With Load; R = 50Ω (RS-422); Figure 1
Differential Output Voltage	1.5		Vcc	Volts	With Load; R = 27Ω (RS-485); Figure 1
Change in Magnitude of Driver Differential Output Voltage for Complimentary states			0.2	Volts	R = 27Ω or R = 50Ω ; Figure 1
Driver Common Mode Output Voltage			3	Volts	R = 27Ω or R = 50Ω; Figure 1
Input High Voltage	2.0			Volts	Applies to DE, D, REB
Input Low Voltage			0.8	Volts	Applies to DE, D, REB
Input Current			+/-10	μA	Applies to DE, D, REB
Driver Short Circuit Current					
V _{OUT} = HIGH			+/-250	mA	-7V ≤ V ₀ ≤ +12V; Figure 8
V _{OUT} = LOW			+/-250	mA	-7V ≤ V ₀ ≤ +12V; Figure 8
SP3491 DRIVER					
AC Characteristics					
Max. Transmission Rate	10			Mbps	
Driver Input to Output, t _{PLH}	20	40	60	ns	Figures 2 & 9
Driver Input to Output, t _{PHL}	20	40	60	ns	Figures 2 & 9
Differential Driver Skew		2		ns	$\begin{array}{c c} t_{\text{PHL}}(\mathbf{Y})\text{-}\ t_{\text{PLH}}(\mathbf{Y}) ,\ t_{\text{PHL}}(\mathbf{Z})\text{-}\ t_{\text{PLH}}(\mathbf{Z}) ,\\ \text{Figures 2 and 9} \end{array}$
Driver Rise or Fall Time		5	20	ns	From 10%-90%; Figures 3 and 10
Driver Enable to Output HIGH		52	120	ns	Figures 4 and 11
Driver Enable to Output LOW		60	120	ns	Figures 5 and 11
Driver Disable from LOW		40	120	ns	Figures 5 and 11
Driver Disable from HIGH		60	120	ns	Figures 4 and 11

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP3491 RECEIVER	•				•
DC Characteristics					
Differential Input Threshold	-0.2		+0.2	Volts	-7V ≤ V _{CM} ≤ +12V
Input Hysteresis		25		mV	V _{CM} = 0V
Output Voltage HIGH	Vcc-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			+/-1	μА	0V ≤ V _o ≤ Vcc; REB = Vcc
Input Resistance	12	15		kΩ	-7V ≤ V _{CM} ≤ +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	$0V \le V_O \le V_{CC}$
SP3491 RECEIVER					
AC Characteristics					
Max. Transmission Rate	10			Mbps	REB = 0V, DE = 0V
Receiver Input to Output, t _{PLH}	40	70	120	ns	Figures 6 and 12
Receiver Input to Output, t _{PLH}			85	ns	T_{AMB} = +25°C, Vcc = 3.3V, Figures 6 and 12
Receiver Input to Output, t _{PHL}	40	70	120	ns	Figures 6 and 12
Receiver Input to Output, t _{PHL}			85	ns	T_{AMB} = +25°C, Vcc = 3.3V, Figures 6 and 12
Differential Receiver Skew		4		ns	$ t_{PHL}(A)-t_{PLH}(A) $, $ t_{PHL}(B)-t_{PLH}(B) $, Figures 6 and 12
Receiver Enable to Output LOW		65	150	ns	Figures 7 and 13; S ₁ Closed, S ₂ open
Receiver Enable to Output HIGH		65	150	ns	Figures 7 and 13; S ₂ Closed, S ₁ open
Receiver Disable from LOW		65	200	ns	Figures 7 and 13; S ₁ Closed, S ₂ open
Receiver Disable from HIGH		65	200	ns	Figures 7 and 13; S ₂ Closed, S ₁ open
POWER REQUIREMENTS					
Supply Voltage	+3.0		+3.6	V	
Supply Current		1000	2000	μΑ	$\overline{\text{REB}}$, D = 0V or V_{cc} ; DE = V_{cc}
Supply Current		800	1500	μΑ	DE = 0V
ESD Protection for R, D, DE, REB, A, B, Y and Z pins		+/-2		kV	Human Body Model

PIN FUNCTION



Pin Function SP3490

Pin 1 - Vcc - Positive supply +3.00V < Vcc < +3.60V

Pin 2 - R - Receiver output

Pin 3 - D - Driver input

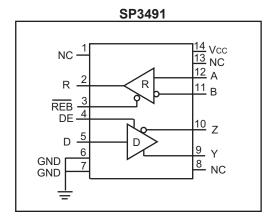
Pin 4 - GND - Ground connection

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



Pin Function SP3491

Pin 1 - NC - No connect

Pin 2 - R - Receiver output

Pin 3 - REB - Receiver cutput 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 - Vcc - Positive supply +3.00V < Vcc < +3.60V

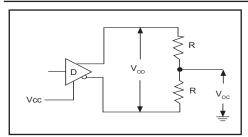


Figure 1. Driver DC Test Load Circuit

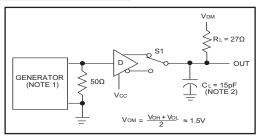


Figure 2. Driver Propagation Delay Test Circuit

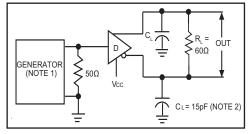


Figure 3. Driver Differential Output Delay and Transition Time Circuit.

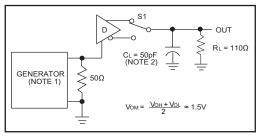


Figure 4. Driver Enable and Disable Timing Circuit, Output High

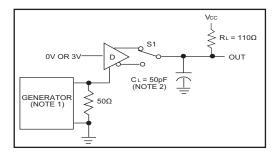


Figure 5. Driver Enable and Disable Timing Circuit, Output Low

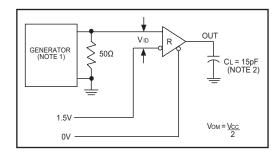


Figure 6. Receiver Propagation Delay Test Circuit

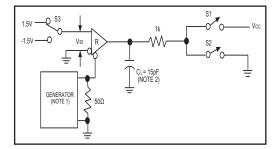


Figure 7. Receiver Enable and Disable Timing Circuit

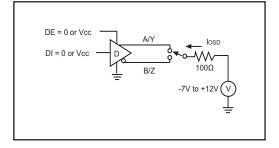


Figure 8. Driver Short Circuit Current Limit Test

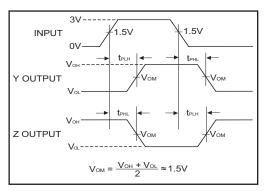
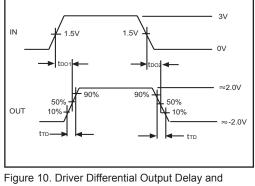


Figure 9. Driver Propagation Delay Waveforms



Transition Time Waveforms

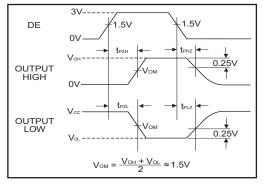


Figure 11. Driver Enable and Disable Timing Waveforms

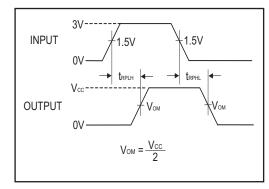


Figure 12. Receiver Propagation Delay Waveforms

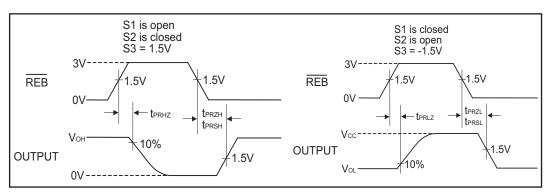


Figure 13. Receiver Enable and Disable Waveforms

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

PRR = 250kHz, 50% duty cycle, $t_R < 6.0$ ns, $Z_Q = 50\Omega$.

NOTE 2: C, includes probe and stray capacitance.

The SP3490 and 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 Exar SP490 and SP491 devices as well as popular industry standards. The SP3490 and SP3491 feature Exar's BiCMOS process allowing low power operation without sacrificing performance.

The RS-485 standard is ideal for multi-drop applications and 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.

Drivers

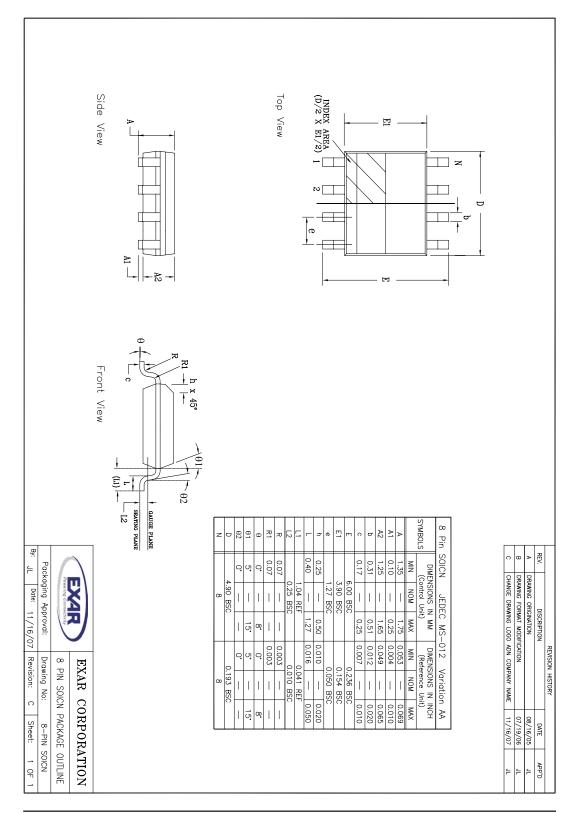
The drivers for both the **SP3490** and **SP3491** have differential outputs. The typical voltage output swing with no load will be 0 volts to Vcc. With worst case loading of 54Ω across the differential outputs, the drivers can maintain greater than 1.5V voltage levels.

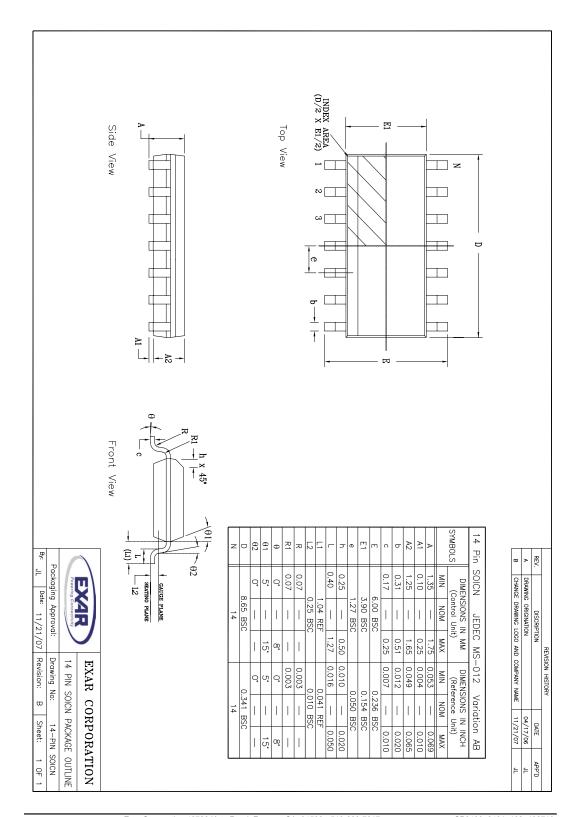
The driver of the **SP3491** has a driver enable control line which is active HIGH. A logic HIGH on DE (pin 4) of the **SP3491** will enable the differential driver outputs. A logic LOW on the DE(pin 4) will tri-state the driver outputs. The **SP3490** does not have a driver enable.

Receivers

The receivers of the **SP3490** and **SP3491** have differential inputs with an input sensitivity of ± 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 **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 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.





	ORDERING INFORMATION	
Model	Temperature Range	Package Types
SP3490CN-L	0°C to +70°C	8-pin NSOIC
SP3490CN-L/TR	0°C to +70°C	8-pin NSOIC
SP3490EN-L	40°C to +85°C	8-pin NSOIC
SP3490EN-L/TR	40°C to +85°C	8-pin NSOIC
SP3491CN-L	0°C to +70°C	14-pin NSOIC
SP3491CN-L/TR	0°C to +70°C	14-pin NSOIC
SP3491EN-L	-40°C to +85°C	14-pin NSOIC
SP3491EN-L/TR	40°C to +85°C	14-pin NSOIC

Note: /TR = Tape and Reel

REVISION HISTORY

DATE	REVISION	DESCRIPTION
10/11/02		Legacy Sipex Datasheet
06/08/10	1.0.0	Convert to Exar Format. Update ordering information as a result of discontinued Lead type package options per PDN 081126-01. Change revision to 1.0.0. Add new Figure 8 - Driver Short Circuit Current Limit Test Circuit
9/14/10	1.0.1	Correct package type for SP3491 options in ordering table from 8 pin NSOIC to 14 pin NSOIC
10/27/10	1.0.2	Add ESD protection levels of +/-2kV. Remove SP3490 Supply Current rating for DE = 0V (No driver enable for SP3490).

Notice

EXAR Corporation reserves the right to make changes to any products contained in this publication in order to improve design, performance or reliability. EXAR Corporation assumes no representation that the circuits are free of patent infringement. Charts and schedules contained herein are only for illustration purposes and may vary depending upon a user's specific application. While the information in this publication has been carefully checked; no responsibility, however, is assumed for inaccuracies.

EXAR Corporation does not recommend the use of any of its products in life support applications where the failure or malfunction of the product can reasonably be expected to cause failure of the life support system or to significantly affect its safety or effectiveness. Products are not authorized for use in such applications unless EXAR Corporation receives, in writting, assurances to its satisfaction that: (a) the risk of injury or damage has been minimized; (b) the user assumes all such risks; (c) potential liability of EXAR Corporation is adequately protected under the circumstances.

Copyright 2010 EXAR Corporation

Datasheet October 2010

For technical support please email Exar's Serial Technical Support group at: serialtechsupport@exar.com

Reproduction, in part or whole, without the prior written consent of EXAR Corporation is prohibited.