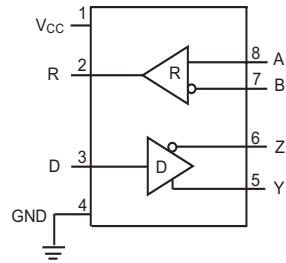




# SP3490/SP3491

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

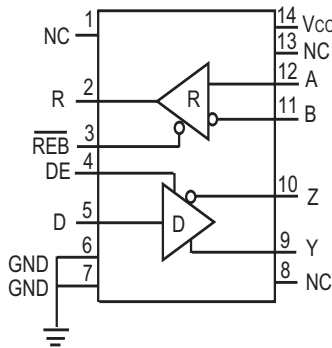
- Full-Duplex RS-485 and RS-422 Transceivers
- Operates from a single +3.3V Supply
- Interoperable with +5.0V logic
- Driver/Receiver Tri-state Enable Lines (**SP3491**)
- -7V to +12V Common-Mode Input Voltage Range
- +/-200mV Receiver Input Sensitivity
- Allows up to 32 transceivers on the serial bus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



SP3490

### 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 receiver tri-state enable lines.

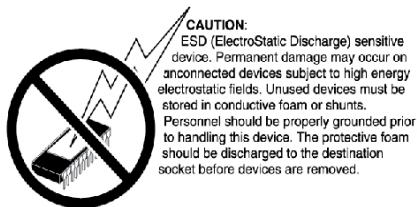


SP3491

## 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> .....	+6.0V
<b>Input Voltages</b>	
Logic.....	-0.3V to +6.0V
Drivers.....	-0.3V to +6.0V
Receivers.....	+/-14V
<b>Output Voltages</b>	
Drivers.....	+/-14V
Receivers.....	-0.3V to +6.0V
Storage Temperature.....	-65°C to +150°C
<b>Power Dissipation</b>	
8-pin NSOIC.....	600mW
	(derate 6.90mW/°C above +70°C)
14-pin NSOIC.....	700mW
	(derate 8.33mW/°C above +70°C)



## ELECTRICAL CHARACTERISTICS

T<sub>AMB</sub> = T<sub>MIN</sub> to T<sub>MAX</sub> and V<sub>CC</sub> = +3.3V +/-5% unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>SP3490 DRIVER</b>					
<b>DC Characteristics</b>					
Differential Output Voltage	GND		V <sub>CC</sub>	Volts	Unloaded; R = ∞Ω ; Figure 1
Differential Output Voltage	2		V <sub>CC</sub>	Volts	With Load; R = 50Ω (RS-422); Figure 1
Differential Output Voltage	1.5		V <sub>CC</sub>	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	
Input Low Voltage			0.8	Volts	
Input Current			+/-10	μA	
Driver Short Circuit Current					
V <sub>OUT</sub> = HIGH			+/-250	mA	-7V ≤ V <sub>O</sub> ≤ +12V; Figure 8
V <sub>OUT</sub> = LOW			+/-250	mA	-7V ≤ V <sub>O</sub> ≤ +12V; Figure 8
<b>SP3490 DRIVER</b>					
<b>AC Characteristics</b>					
Max. Transmission Rate	10			Mbps	
Driver Input to Output, t <sub>PLH</sub>	20	40	60	ns	R = 27Ω, Figures 2 & 9
Driver Input to Output, t <sub>PHL</sub>	20	40	60	ns	R = 27Ω, Figures 2 & 9
Differential Driver Skew		2		ns	t <sub>PHL</sub> (Y) - t <sub>PLH</sub> (Y) ,  t <sub>PHL</sub> (Z) - t <sub>PLH</sub> (Z) , Figures 2 and 9
Driver Rise or Fall Time		5	20	ns	From 10%-90%; Figures 3 and 10

## ELECTRICAL CHARACTERISTICS

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>SP3490 RECEIVER</b>					
<b>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	$0V \leq V_O \leq V_{CC}$
<b>SP3490 RECEIVER</b>					
<b>AC Characteristics</b>					
Max. Transmission Rate	10			Mbps	
Receiver Input to Output, $t_{PLH}$	40	70	120	ns	Figures 6 and 12
Receiver Input to Output, $t_{PLH}$			85	ns	$T_{AMB} = +25^\circ C, V_{CC} = 3.3V$ 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	$T_{AMB} = +25^\circ C, V_{CC} = 3.3V$ 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
<b>POWER REQUIREMENTS</b>					
Supply Voltage	3.0	3.3	3.6	V	
Supply Current		1000	2000	$\mu A$	$D = 0V$ or $V_{CC}$
ESD Protection for D, R, A, B, Y and Z pins		+/-2		kV	Human Body Model

## ELECTRICAL CHARACTERISTICS

$T_{AMB} = T_{MIN}$  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 <sub>CC</sub>	Volts	Unloaded; R = ∞Ω ; Figure 1
Differential Output Voltage	2		V <sub>CC</sub>	Volts	With Load; R = 50Ω (RS-422); Figure 1
Differential Output Voltage	1.5		V <sub>CC</sub>	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, $\overline{REB}$
Input Low Voltage			0.8	Volts	Applies to DE, D, $\overline{REB}$
Input Current			+/-10	μA	Applies to DE, D, $\overline{REB}$
Driver Short Circuit Current					
V <sub>OUT</sub> = HIGH			+/-250	mA	-7V ≤ V <sub>O</sub> ≤ +12V; Figure 8
V <sub>OUT</sub> = LOW			+/-250	mA	-7V ≤ V <sub>O</sub> ≤ +12V; Figure 8
<b>SP3491 DRIVER</b>					
<b>AC Characteristics</b>					
Max. Transmission Rate	10			Mbps	
Driver Input to Output, t <sub>PLH</sub>	20	40	60	ns	Figures 2 & 9
Driver Input to Output, t <sub>PHL</sub>	20	40	60	ns	Figures 2 & 9
Differential Driver Skew		2		ns	t <sub>PHL</sub> (Y) - t <sub>PLH</sub> (Y) ,  t <sub>PHL</sub> (Z) - t <sub>PLH</sub> (Z) , Figures 2 and 9
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

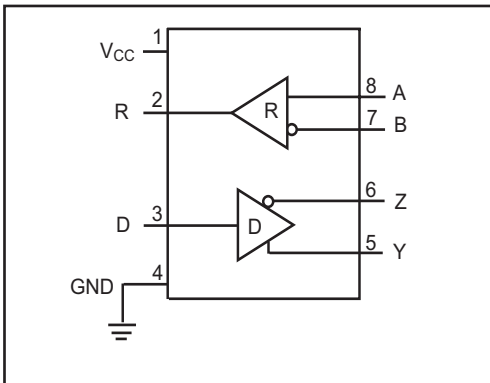
## ELECTRICAL CHARACTERISTICS

$T_{AMB} = T_{MIN}$  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			+/-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>					
Max. Transmission Rate	10			Mbps	$\overline{REB} = 0V, DE = 0V$
Receiver Input to Output, $t_{PLH}$	40	70	120	ns	Figures 6 and 12
Receiver Input to Output, $t_{PLH}$			85	ns	$T_{AMB} = +25^\circ C, V_{CC} = 3.3V$ , 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	$T_{AMB} = +25^\circ C, V_{CC} = 3.3V$ , 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
<b>POWER REQUIREMENTS</b>					
Supply Voltage	+3.0		+3.6	V	
Supply Current		1000	2000	$\mu A$	$\overline{REB}, D = 0V$ or $V_{CC}; DE = V_{CC}$
Supply Current		800	1500	$\mu A$	$DE = 0V$
ESD Protection for R, D, DE, REB, A, B, Y and Z pins		+/-2		kV	Human Body Model

## PIN FUNCTION

### SP3490



### Pin Function SP3490

Pin 1 - V<sub>CC</sub> - Positive supply +3.00V < V<sub>CC</sub> < +3.60V

Pin 2 - R - Receiver output

Pin 3 - D - Driver input

Pin 4 - GND - Ground connection

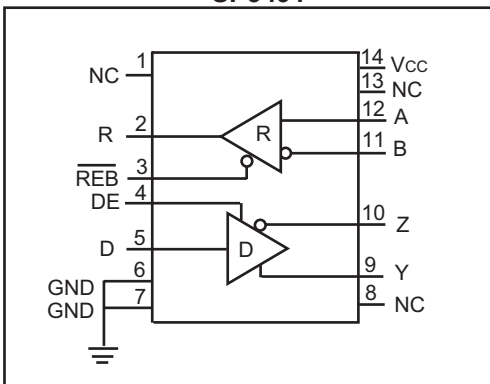
Pin 5 - Y - Non-inverting driver output

Pin 6 - Z - Inverting driver output

Pin 7 - B - Inverting receiver Input

Pin 8 - A - Non-inverting receiver input

### SP3491



### Pin Function SP3491

Pin 1 - NC - No connect

Pin 2 - R - Receiver output

Pin 3 -  $\overline{\text{REB}}$  - 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<sub>CC</sub> - Positive supply +3.00V < V<sub>CC</sub> < +3.60V

## TEST CIRCUITS

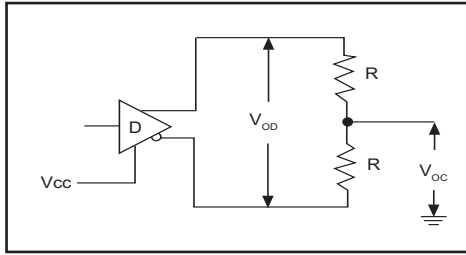


Figure 1. Driver DC Test Load Circuit

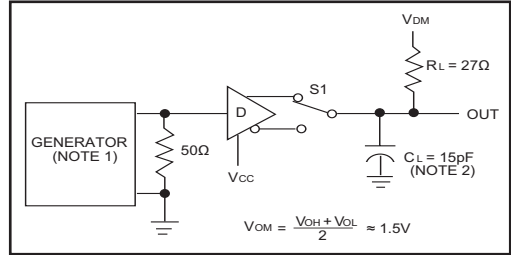


Figure 2. Driver Propagation Delay Test Circuit

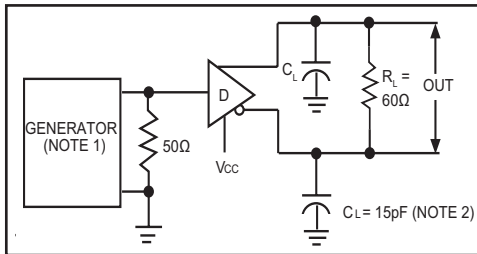


Figure 3. Driver Differential Output Delay and Transition Time Circuit.

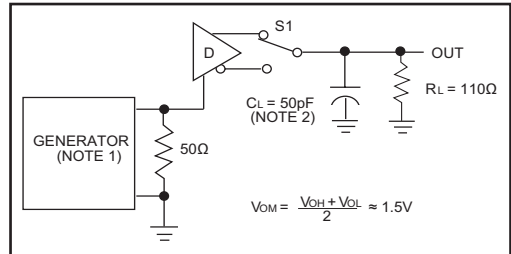


Figure 4. Driver Enable and Disable Timing Circuit, Output High

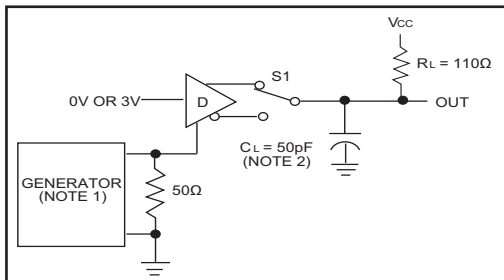


Figure 5. Driver Enable and Disable Timing Circuit, Output Low

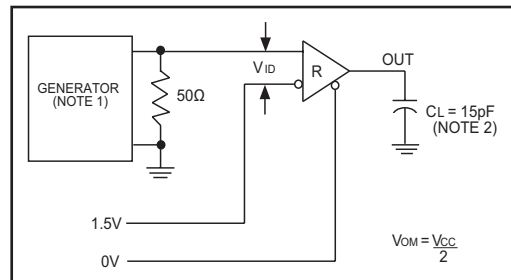


Figure 6. Receiver Propagation Delay Test Circuit

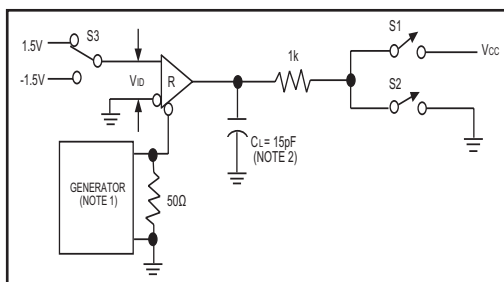


Figure 7. Receiver Enable and Disable Timing Circuit

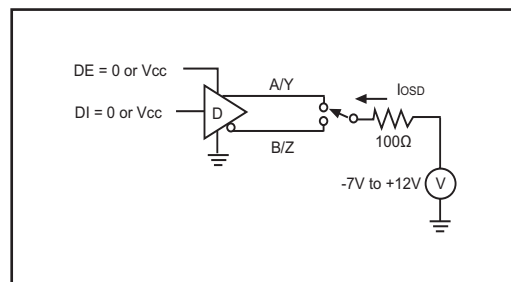


Figure 8. Driver Short Circuit Current Limit Test

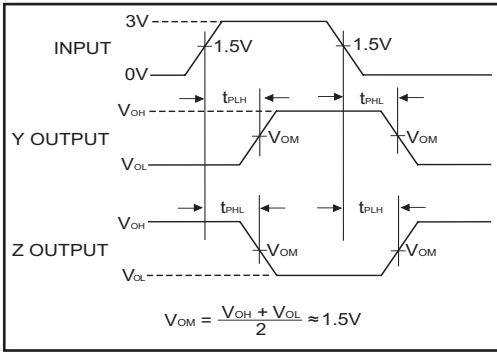


Figure 9. Driver Propagation Delay Waveforms

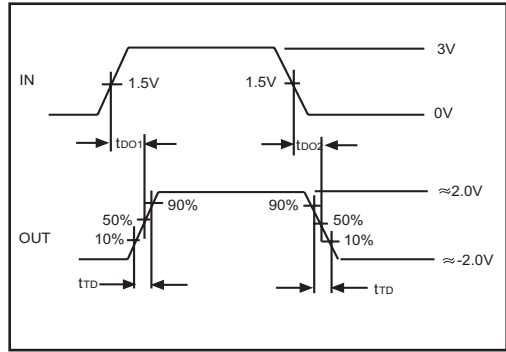


Figure 10. Driver Differential Output Delay and Transition Time Waveforms

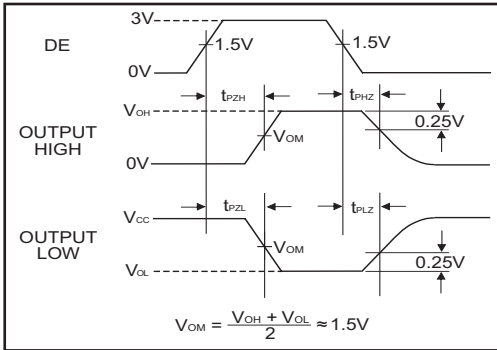


Figure 11. Driver Enable and Disable Timing Waveforms

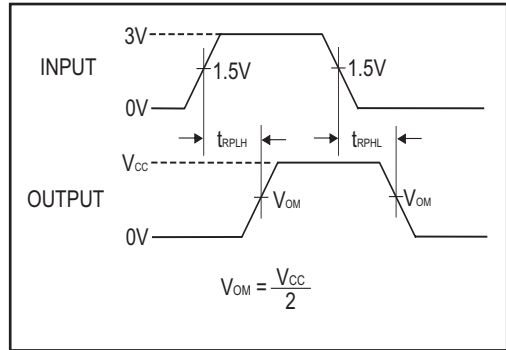


Figure 12. Receiver Propagation Delay Waveforms

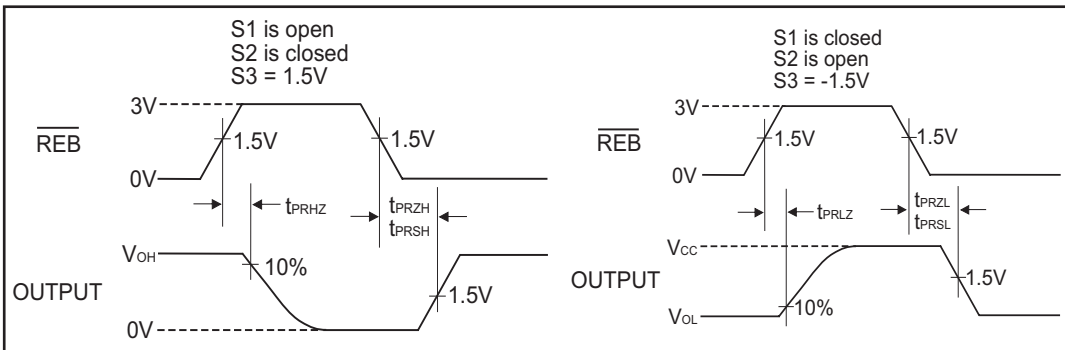


Figure 13. Receiver Enable and Disable Waveforms

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

PRR = 250kHz, 50% duty cycle,  $t_r < 6.0\text{ns}$ ,  $Z_o = 50\Omega$ .

NOTE 2:  $C_L$  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  $V_{CC}$ . With worst case loading of  $54\Omega$  across the differential outputs, the drivers can maintain greater than 1.5V voltage levels.

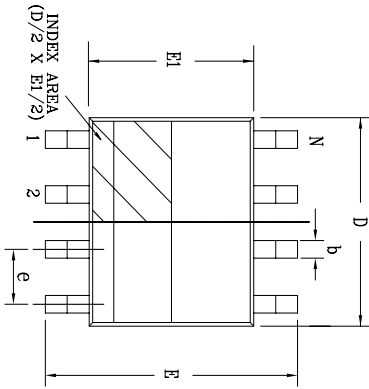
The driver of the **SP3491** has a driver enable control line which is active HIGH. A logic HIGH on DE (pin 4) of the **SP3491** will enable the differential driver outputs. A logic LOW on the DE(pin 4) will tri-state the driver outputs. The **SP3490** does not have a driver enable.

## Receivers

The receivers of the **SP3490** and **SP3491** have differential inputs with an input sensitivity of  $\pm 200\text{mV}$ . 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 **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.

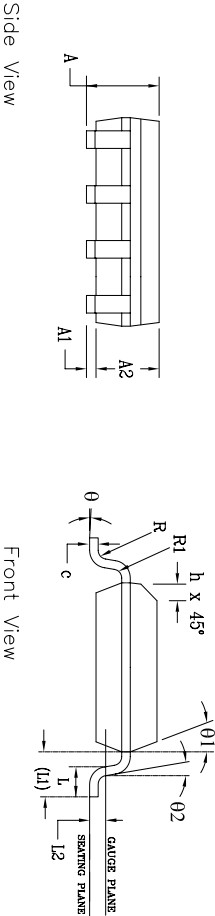
The receiver of the **SP3491** has a enable control line which is active LOW. A logic LOW on  $\overline{\text{REB}}$  (pin 3) of the **SP3491** will enable the differential receiver. A logic HIGH on REB (pin 3) of the **SP3491** will tri-state the receiver.

REVISION HISTORY			
REV	DESCRIPTION	DATE	APP'D
A	DRAWING ORIGINATOR	08/16/05	JL
B	DRAWING FORMAT MODIFICATION	07/19/06	JL
C	CHANGE DRAWING LOGO AND COMPANY NAME	11/16/07	JL



Top View

SYMBOLS	8 Pin SOICN			JEDEC MS-012			Variation AA		
	DIMENSIONS IN MM (Control Unit)			DIMENSIONS IN INCH (Reference Unit)					
	MIN	NOM	MAX	MIN	NOM	MAX			
A	1.35	—	1.75	0.053	—	0.069			
A1	0.10	—	0.25	0.004	—	0.010			
A2	1.25	—	1.65	0.049	—	0.065			
b	0.31	—	0.51	0.012	—	0.020			
c	0.17	—	0.25	0.007	—	0.010			
E	6.00 BSC			0.236 BSC					
E1	3.90 BSC			0.154 BSC					
e	0.25	—	0.50	0.010	—	0.020			
h	0.40	—	1.27	0.016	—	0.050			
L	1.04 REF			0.041 REF					
L1	0.25 BSC			0.010 BSC					
L2	—			—					
R	0.07	—	—	0.003	—	—			
R1	0.07	—	—	0.003	—	—			
θ	0°	—	8°	0°	—	8°			
θ1	5°	—	15°	5°	—	15°			
θ2	0°	—	—	0°	—	—			
D	4.90 BSC			0.193 BSC					
N	8			8					

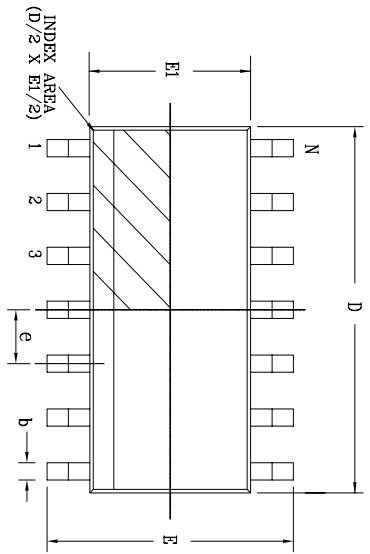


Front View

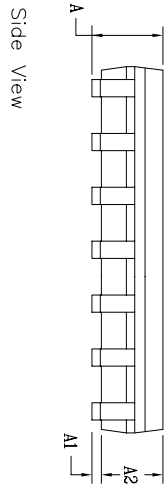
Side View

		<b>EXAR CORPORATION</b> <i>Revolving Connectivity</i>	
Packaging Approval:		Drawing No:	
By: JL	Date: 11/16/07	C	8-PIN SOICN
Revision:		Sheet:	
C		1 OF 1	

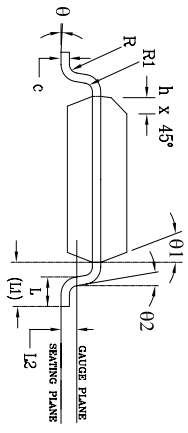
REVISION HISTORY			
REV.	DESCRIPTION	DATE	APP'D
A	DRAWING ORIGINATOR	04/17/06	JL
B	CHANGE DRAWING LOGO AND COMPANY NAME	11/21/07	JL



Top View



Side View



Front View

14 Pin SOICN		JEDEC MS-012		Variation AB		
SYMBOLS	DIMENSIONS IN MM (Control Unit)			DIMENSIONS IN INCH (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	—	1.75	0.053	—	0.069
A1	0.10	—	0.25	0.004	—	0.010
A2	1.25	—	1.65	0.049	—	0.065
b	0.31	—	0.51	0.012	—	0.020
c	0.17	—	0.25	0.007	—	0.010
E	6.00	BSC	—	0.236	BSC	—
E1	3.90	BSC	—	0.154	BSC	—
e	0.25	—	0.50	0.010	—	0.020
L	0.40	—	1.27	0.016	—	0.050
L1	—	1.04	REF	—	0.041	REF
L2	—	0.25	BSC	—	0.010	BSC
R	0.07	—	—	0.003	—	—
R1	0.07	—	—	0.003	—	—
θ	0°	—	8°	0°	—	8°
θ1	5°	—	15°	5°	—	15°
θ2	0°	—	—	0°	—	—
D	—	8.65	BSC	—	0.341	BSC
N	—	14	—	—	14	—

		<b>EXAR CORPORATION</b> <small>Powering Connectivity</small>	
		14 PIN SOICN PACKAGE OUTLINE	
Packaging Approval:		Drawing No.:	
By: JL	Date: 11/21/07	Revision: B	Sheet: 1 OF 1

## 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).

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