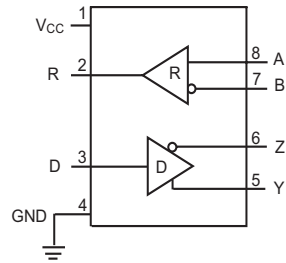# SP3490/SP3491

+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
- Compatability with LTC490 and SN75179 (**SP3490**)
- Compatability 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 reciveiver tri-state enable lines.
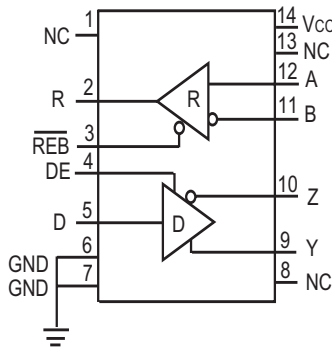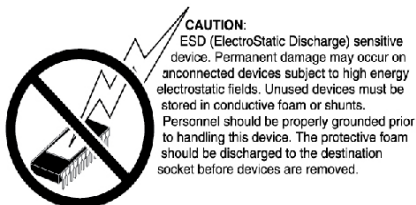
SP3491

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_{CC}..+6.0V
Input Voltages
     Logic....................................-0.3V to +6.0V
     Drivers................................-0.3V to +6.0V
     Receivers..+/-14V
Output Voltages
     Drivers..+/-14V
     Receivers............................-0.3V to +6.0V
Storage Temperature.......................-65˚C to +150˚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)

CAUTION:
ESD (ElectroStatic Discharge) sensitive device. Permanent damage may occur on unconnected devices subject to high energy electrostatic fields. Unused devices must be stored in conductive foam or shunts. Personnel should be properly grounded prior to handling this device. The protective foam should be discharged to the destination socket before devices are removed.

ELECTRICAL CHARACTERISTICS

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

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 = 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_{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	|$t_{PHL}(Y)$- $t_{PLH}(Y)$|, |$t_{PHL}(Z)$- $t_{PLH}(Z)$|, Figures 2 and 9
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.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP3490 RECEIVER					
DC Characteristics					
Differential Input Threshold	-0.2		+0.2	Volts	$-7V \leq V_{CM} \leq +12V$
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	$-7V \leq V_{CM} \leq +12V$
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	$0V \leq V_O \leq V_{CC}$
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, 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
POWER REQUIREMENTS					
Supply Voltage	3.0	3.3	3.6	V	
Supply Current		1000	2000	µA	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, $\overline{REB}$
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_{OUT} = HIGH			+/-250	mA	-7V ≤ V_O ≤ +12V; Figure 8
V_{OUT} = LOW			+/-250	mA	-7V ≤ V_O ≤ +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	$|t_{PHL}(Y)- t_{PLH}(Y)|, |t_{PHL}(Z)- t_{PLH}(Z)|$, 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

$T_{AMB} = T_{MIN}$ to T_{MAX} and V_{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	$-7V \leq V_{CM} \leq +12V$
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	µA	$0V \leq V_O \leq Vcc$; $\overline{REB}$ = Vcc
Input Resistance	12	15		kΩ	$-7V \leq V_{CM} \leq +12V$
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	$0V \leq V_O \leq V_{CC}$
SP3491 RECEIVER					
AC Characteristics					
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°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	$\lvert t_{PHL}(A) - t_{PLH}(A) \rvert$, $\lvert t_{PHL}(B) - t_{PLH}(B) \rvert$, 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	µA	$\overline{REB}$, D = 0V or V_{CC}; DE = V_{CC}
Supply Current		800	1500	µA	DE = 0V
ESD Protection for R, D, DE, $\overline{REB}$, A, B, Y and Z pins		+/-2		kV	Human Body Model

SP3490

Pin Function SP3490
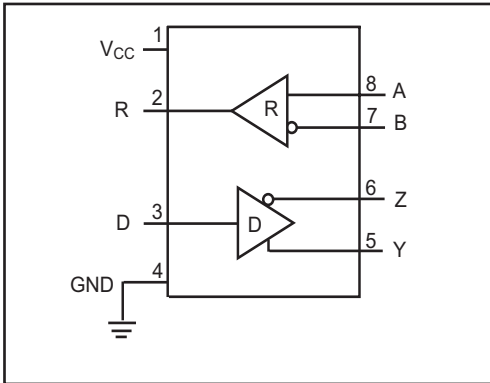
Pin 1 - Vcc - Positive supply +3.00V < Vcc < +3.60V

Pin 2 - R - Receiver output

Pin 3 - D - Driver input
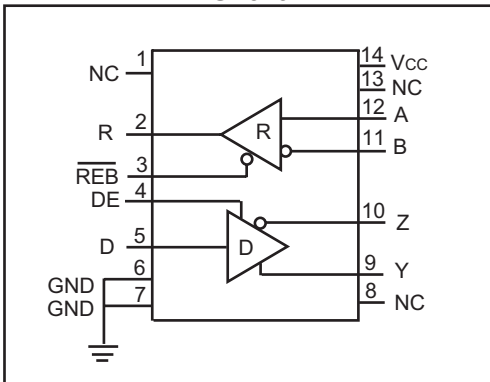
Pin 4 - GND - Ground connection

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

SP3491

Pin Function SP3491

Pin 1 - NC - No connect

Pin 2 - R - Receiver output

Pin 3 - $\overline{REB}$ - 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 - Vcc - Positive supply +3.00V < Vcc < +3.60V
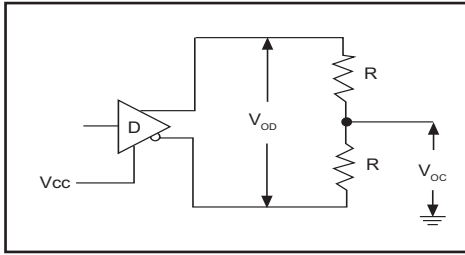
Figure 1. Driver DC Test Load Circuit
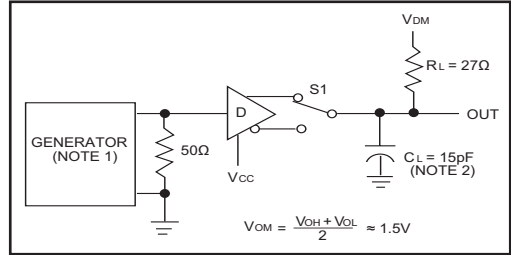
Figure 2. Driver Propagation Delay Test Circuit

$$V_{OM} = \frac{V_{OH} + V_{OL}}{2} \approx 1.5V$$
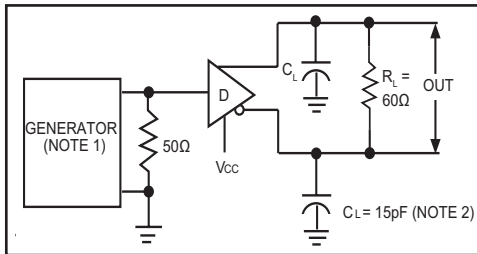
Figure 3. Driver Differential Output Delay and Transition Time Circuit.
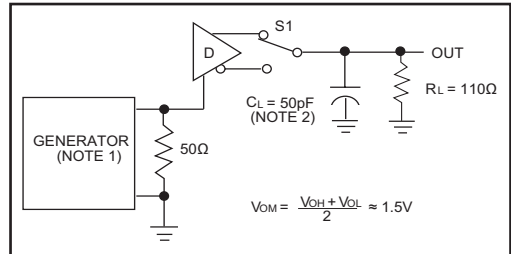
Figure 4. Driver Enable and Disable Timing Circuit, Output High

$$V_{OM} = \frac{V_{OH} + V_{OL}}{2} \approx 1.5V$$
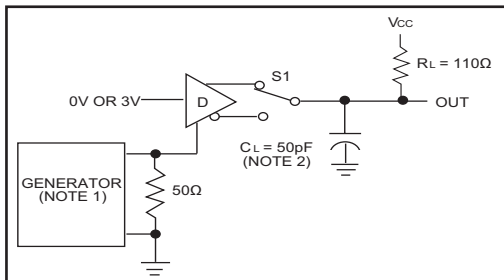
Figure 5. Driver Enable and Disable Timing Circuit, Output Low
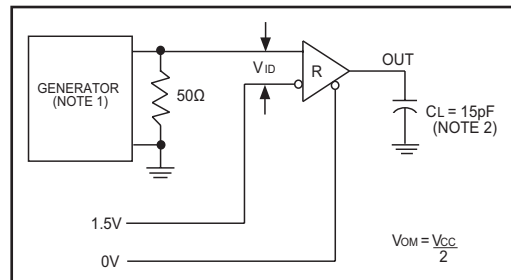
Figure 6. Receiver Propagation Delay Test Circuit

$$V_{OM} = \frac{V_{CC}}{2}$$
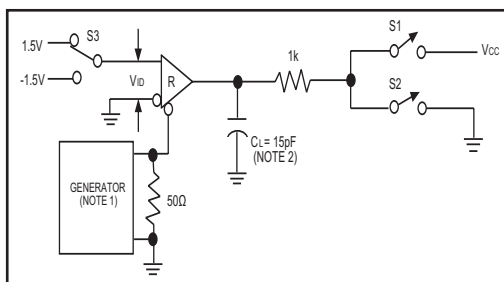
Figure 7. Receiver Enable and Disable Timing Circuit
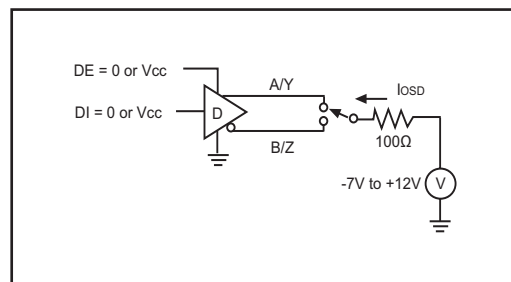
Figure 8. Driver Short Circuit Current Limit Test
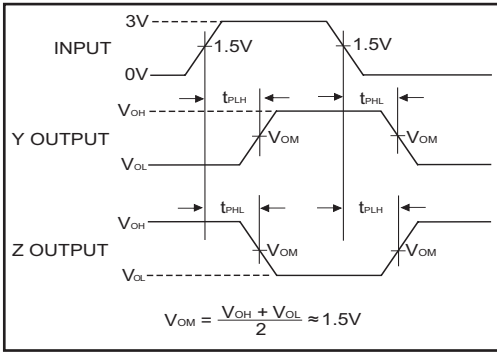
Figure 9. Driver Propagation Delay Waveforms
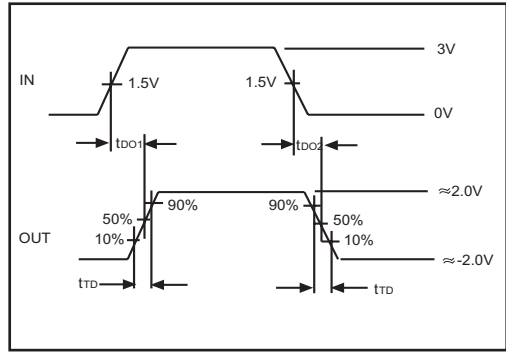
Figure 10. Driver Differential Output Delay and Transition Time Waveforms
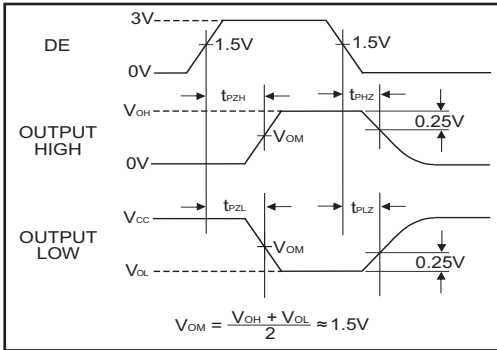
Figure 11. Driver Enable and Disable Timing Waveforms
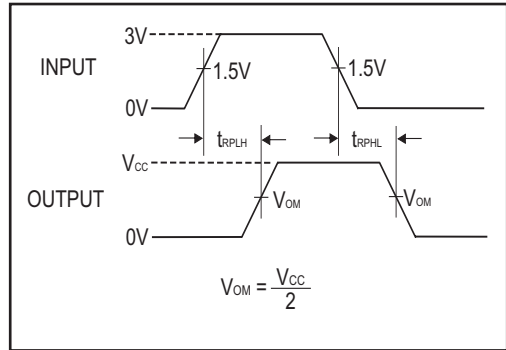
Figure 12. Receiver Propagation Delay Waveforms

$$V_{OM} = \frac{V_{OH} + V_{OL}}{2} \approx 1.5V$$

$$V_{OM} = \frac{V_{CC}}{2}$$
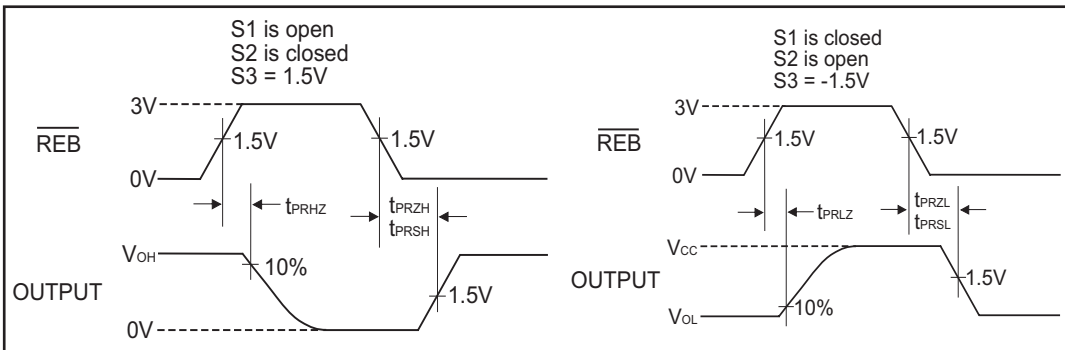
Figure 13. Receiver Enable and Disable Waveforms

NOTE 1: The input pulse is supplied by a generator with the following characteristics:
PRR = 250kHz, 50% duty cycle, t_R < 6.0ns, Z_O = 50Ω.
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 Vcc. With worst case loading of 54Ω across the differential outputs, the drivers can maintain greater than 1.5V voltage levels.
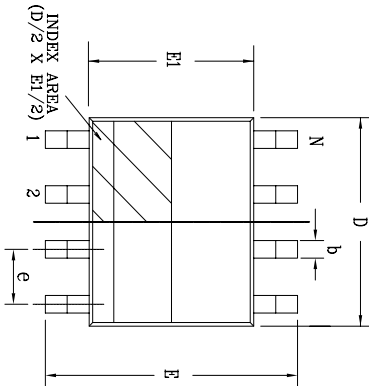
The driver of the **SP3491** has a driver enable control line which is active HIGH. A logic HIGH on DE (pin 4) of the **SP3491** will enable the differential driver outputs. A logic LOW on the DE(pin 4) will tri-state the driver outputs. The **SP3490** does not have a driver enable.
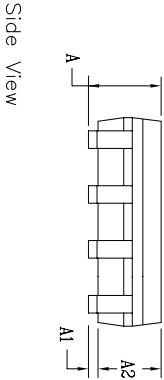
Receivers

The receivers of the **SP3490** and **SP3491** have differential inputs with an input sensitivity of ±200mV. Input impedance of the receivers is typically 15kΩ (12kΩ 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.
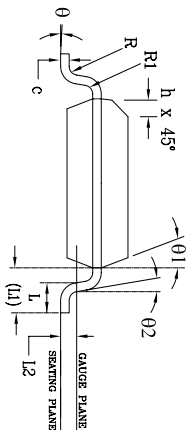
Side View

Top View

INDEX AREA (D/2 X E1/2)

Front View

8 Pin SOICN   JEDEC MS-012   Variation AA

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
E1	3.90 BSC			0.154 BSC		
E	6.00 BSC			0.236 BSC		
e	1.27 BSC			0.050 BSC		
h	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	4.90 BSC			0.193 BSC		
N	8			8		

EXAR CORPORATION

EXAR Powering Connectivity

8 PIN SOICN PACKAGE OUTLINE

Packaging Approval:
By: JL
Date: 11/16/07
Drawing No: 8-PIN SOICN
Revision: C
Sheet: 1 OF 1

Side View

Top View

Front View

INDEX AREA (D/2 X E1/2)

θ
R
R1
c
h x 45°
θ1
θ2
L
(L1)
L2
SEATING PLANE
GAUGE PLANE

A
A1
A2

E1
N
1 2 3
e
b
D
E
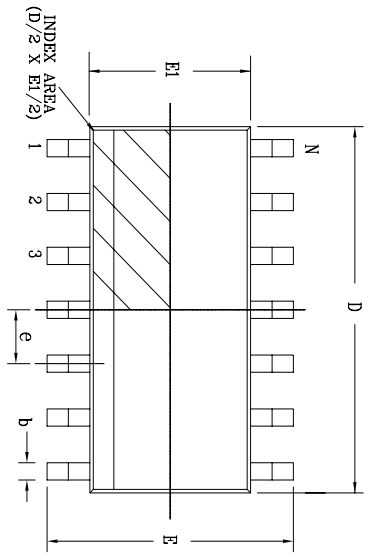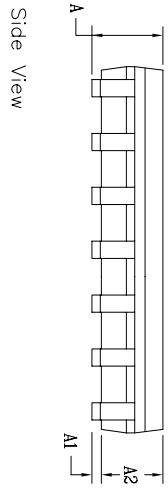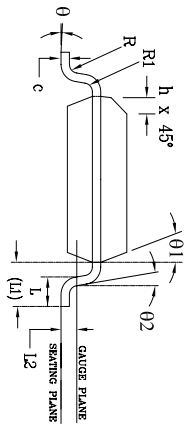
14 Pin SOICN JEDEC MS-012 Variation AB

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		1.27 BSC			0.050 BSC	
h	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	

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).