

### Description

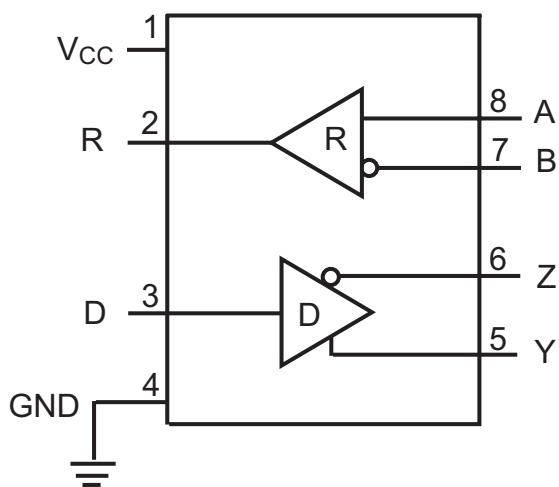
The SP490E is a low power differential line driver/receiver meeting RS-485 and RS-422 standards up to 10Mbps. The SP491E is identical to the SP490E with the addition of driver and receiver tri-state enable lines. Both products feature  $\pm 200\text{mV}$  receiver input sensitivity, over wide common mode range. The SP490E is available in 8-pin NSOIC packages for operation over the commercial and industrial temperature ranges. The SP491E is available in 14-pin NSOIC packages for operation over the commercial and industrial temperature ranges.

### FEATURES

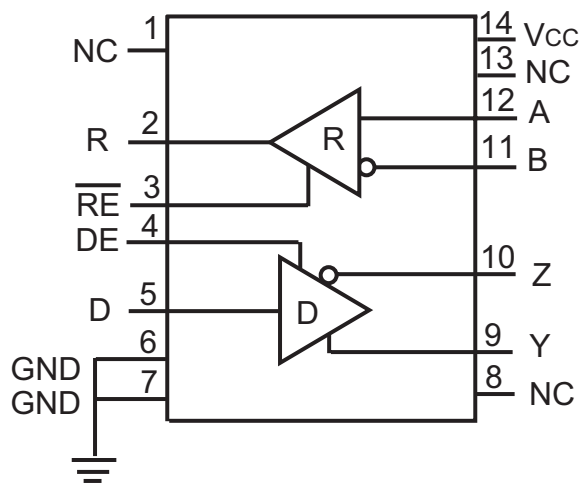
- 5V only
- Low power BiCMOS
- Driver/receiver enable (SP491E)
- RS-485 and RS-422 drivers/receivers
- Pin compatible with LTC490 and SN75179 (SP490E)
- Pin compatible with LTC491 and SN75180 (SP491E)
- Improved ESD specifications:
  - $\pm 15\text{kV}$  Human Body Model
  - $\pm 15\text{kV}$  IEC61000-4-2 Air Discharge

Ordering Information - [Back Page](#)

### Block Diagrams



SP490E



SP491E

## Absolute Maximum Ratings (SP490E)

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.

$V_{CC}$ .....7.0V

### Input Voltages

Drivers.....-0.5V to ( $V_{CC} + 0.5V$ )

Receivers..... $\pm 14V$

### Output Voltages

Drivers..... $\pm 14V$

Receivers.....-0.5V to ( $V_{CC} + 0.5V$ )

Storage Temperature.....-65°C to +150°C

Power Dissipation.....1000mW

## Electrical Characteristics

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>SP490E Driver DC Characteristics</b>					
Differential output voltage			$V_{CC}$	V	Unloaded; $R = \infty\Omega$ ; Figure 1
Differential output voltage	2		$V_{CC}$	V	With load; $R = 50\Omega$ (RS-422); Figure 1
Differential output voltage	1.5		$V_{CC}$	V	With load; $R = 27\Omega$ (RS-485); Figure 1
Change in magnitude of driver differential output voltage for complimentary states			0.2	V	$R = 27\Omega$ or $R = 50\Omega$ ; Figure 1
Driver common-mode output voltage			3	V	$R = 27\Omega$ or $R = 50\Omega$ ; Figure 1
Input high voltage	2.0			V	Applies to D
Input low voltage			0.8	V	Applies to D
Input current			$\pm 10$	$\mu A$	Applies to D
Driver short circuit current $V_{OUT} = HIGH$			$\pm 250$	mA	$-7V \leq V_O \leq 12V$
Driver short circuit current $V_{OUT} = LOW$			$\pm 250$	mA	$-7V \leq V_O \leq 12V$
<b>SP490E Driver AC Characteristics</b>					
Maximum data rate	10			Mbps	
Driver input to output, $t_{PLH}$		30	60	ns	$R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 5
Driver input to output, $t_{PHL}$		30	60	ns	$R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 5
Driver skew		5		ns	$t_{SKEW} =  t_{DPLH} - t_{DPLH} $ ; Figures 3 & 5
Driver rise or fall time		15	40	ns	From 10%-90%; $R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 5

## Electrical Characteristics (Continued)

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>SP490E Receiver DC Characteristics</b>					
Differential input threshold	-0.2		0.2	Volts	$-7V \leq V_{CM} \leq 12V$
Input hysteresis		70		mV	$V_{CM} = 0V$
Output voltage HIGH	3.5			Volts	$V_{ID} = 200mV, I_O = -4mA$
Output voltage LOW			0.4	Volts	$V_{ID} = -200mV, I_O = 4mA$
Input resistance	12	15		k $\Omega$	$-7V \leq V_{CM} \leq 12V$
Input current (A, B); $V_{IN} = 12V$			$\pm 1.0$	mA	$V_{IN} = 12V$
Input current (A, B); $V_{IN} = -7V$			-0.8	mA	$V_{IN} = -7V$
Short circuit current			85	mA	$0V \leq V_O \leq V_{CC}$
<b>SP490E Receiver AC Characteristics</b>					
Maximum data rate	10			Mbps	
Receiver input to output, $t_{PLH}$	20	45	100	ns	$R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100pF$ ; Figures 3 and 7
Receiver input to output, $t_{PHL}$	20	45	100	ns	$R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100pF$ ; Figures 3 and 7
Differential receiver skew, $ t_{PLH} - t_{PHL} $		13		ns	$R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100pF$ ; Figures 3 and 7
<b>Power Requirements</b>					
Supply Voltage	4.75		5.25	V	
Supply Current		900		$\mu A$	
<b>SP490E Environmental and Mechanical</b>					
Operating Temperature					
Commercial ( $_C$ )	0		70	$^{\circ}C$	
Industrial ( $_E$ )	-40		85	$^{\circ}C$	
Storage Temperature	-65		150	$^{\circ}C$	
Package					
NSOIC ( $_N$ )					

Test Circuits

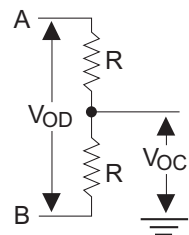


Figure 1: Driver DC Test Load Circuit

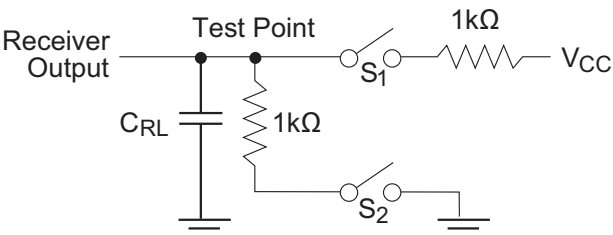


Figure 2: Receiver Timing Test Load Circuit

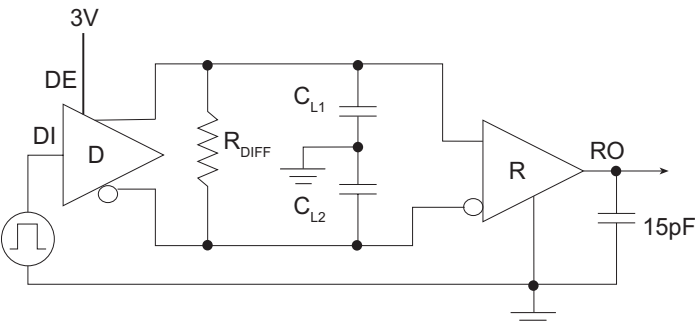


Figure 3: Driver/Receiver Timing Test Circuit

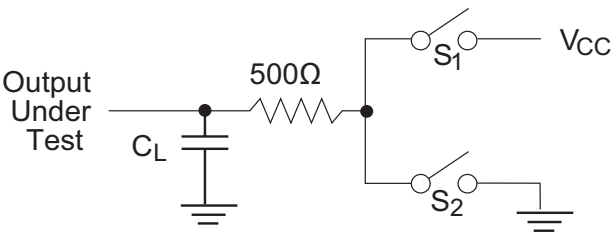


Figure 4: Driver Timing Test Load #2 Circuit

## Switching Waveforms

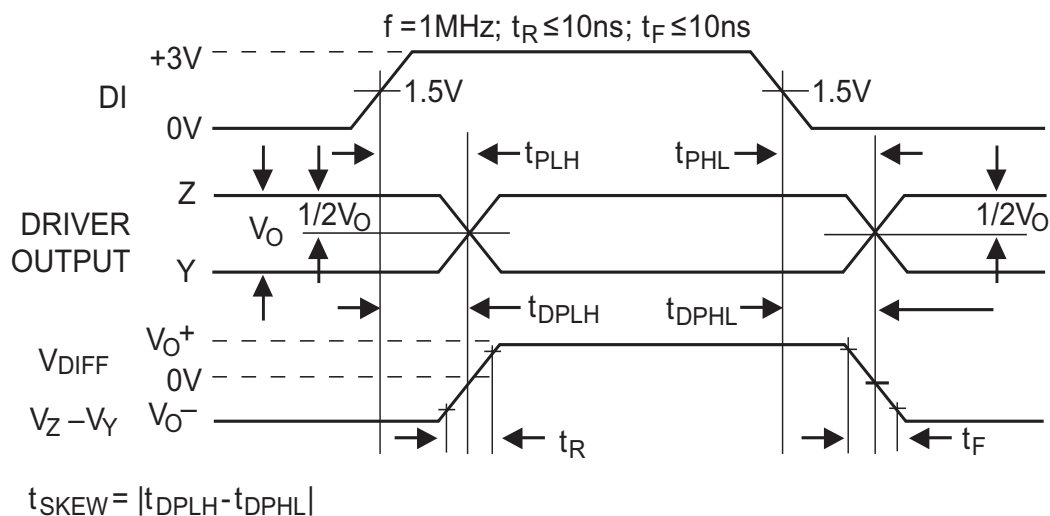


Figure 5: Driver Propagation Delays

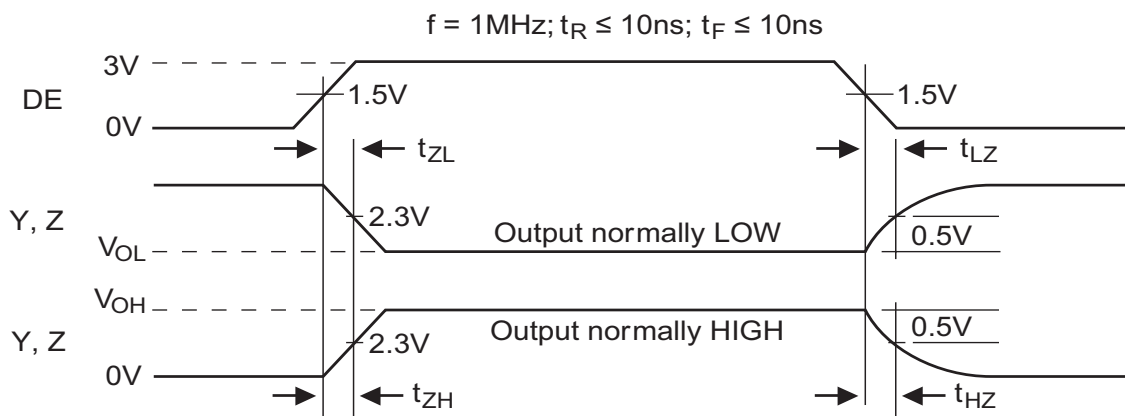


Figure 6: Driver Enable and Disable Times

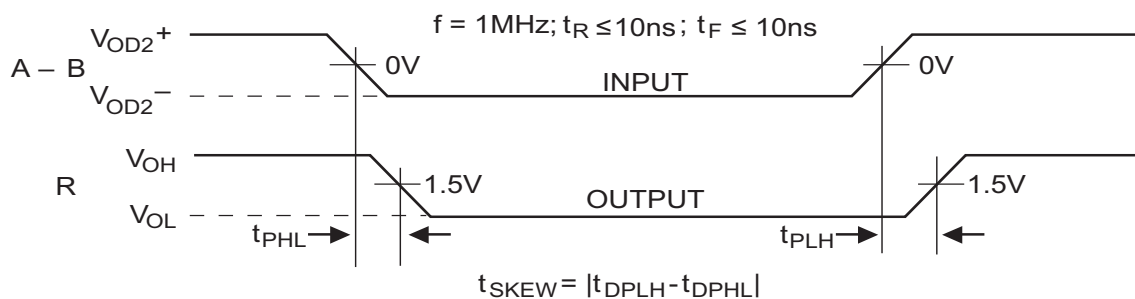


Figure 7: Receiver Propagation Delays

## Absolute Maximum Ratings (SP491E)

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.

$V_{CC}$ .....7.0V

### Input Voltages

Logic.....-0.5V to ( $V_{CC} + 0.5V$ )

Drivers.....-0.5V to ( $V_{CC} + 0.5V$ )

Receivers..... $\pm 14V$

### Output Voltages

Logic.....-0.5V to ( $V_{CC} + 0.5V$ )

Drivers..... $\pm 14V$

Receivers.....-0.5V to ( $V_{CC} + 0.5V$ )

Storage Temperature.....-65°C to 150°C

Power Dissipation.....1000mW

## Electrical Characteristics

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>SP491E Driver DC Characteristics</b>					
Differential output voltage			$V_{CC}$	V	Unloaded; $R = \infty\Omega$ ; Figure 1
Differential output voltage	2		$V_{CC}$	V	With load; $R = 50\Omega$ (RS-422); Figure 1
Differential output voltage	1.5		$V_{CC}$	V	With load; $R = 27\Omega$ (RS-485); Figure 1
Change in magnitude of driver differential output voltage for complimentary states			0.2	V	$R = 27\Omega$ or $R = 50\Omega$ ; Figure 1
Driver common-mode output voltage			3	V	$R = 27\Omega$ or $R = 50\Omega$ ; Figure 1
Input high voltage	2.0			V	Applies to DE, D, $\overline{RE}$
Input low voltage			0.8	V	Applies to DE, D, $\overline{RE}$
Input current			$\pm 10$	$\mu A$	Applies to DE, D, $\overline{RE}$
Driver short circuit current $V_{OUT} = HIGH$			$\pm 250$	mA	$-7V \leq V_O \leq 12V$
Driver short circuit current $V_{OUT} = LOW$			$\pm 250$	mA	$-7V \leq V_O \leq 12V$

## Electrical Characteristics (Continued)

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>SP491E Driver AC Characteristics</b>					
Maximum data rate	10			Mbps	$\overline{RE} = 5V$ , $DE = 5V$
Driver input to output, $t_{PLH}$		30	60	ns	$R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 5
Driver input to output, $t_{PHL}$		30	60	ns	$R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 5
Driver skew		5	10	ns	$t_{SKEW} =  t_{DPLH} - t_{DPLH} $ ; Figures 3 & 5
Driver rise or fall time		15	40	ns	From 10%-90%; $R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 5
Driver enable to output HIGH		40	70	ns	$C_{L1} = C_{L2} = 100pF$ ; Figures 4 & 6, $S_2$ closed
Driver enable to output LOW		40	70	ns	$C_{L1} = C_{L2} = 100pF$ ; Figures 4 & 6, $S_1$ closed
Driver disable time from LOW		40	70	ns	$C_{L1} = C_{L2} = 100pF$ ; Figures 4 & 6, $S_1$ closed
Driver disable time from HIGH		40	70	ns	$C_{L1} = C_{L2} = 100pF$ ; Figures 4 & 6, $S_2$ closed
<b>SP491E Receiver DC Characteristics</b>					
Differential input threshold	-0.2		0.2	Volts	$-7V \leq V_{CM} \leq 12V$
Input hysteresis		70		mV	$V_{CM} = 0V$
Output voltage HIGH	3.5			Volts	$V_{ID} = 200mV$ , $I_O = -4mA$
Output voltage LOW			0.4	Volts	$V_{ID} = -200mV$ , $I_O = 4mA$
Three-State ( High Impedance) Output Current			$\pm 1$	$\mu A$	$0.4V \leq V_O \leq 2.4V$ ; $\overline{RE} = 5V$
Input resistance	12	15		k $\Omega$	$-7V \leq V_{CM} \leq 12V$
Input current (A, B); $V_{IN} = 12V$			$\pm 1.0$	mA	$DE = 0V$ , $V_{CC} = 0V$ or $5.25V$ , $V_{IN} = 12V$
Input current (A, B); $V_{IN} = -7V$			-0.8	mA	$DE = 0V$ , $V_{CC} = 0V$ or $5.25V$ , $V_{IN} = -7V$
Short circuit current			85	mA	$0V \leq V_O \leq V_{CC}$
<b>SP491E Receiver AC Characteristics</b>					
Maximum data rate	10			Mbps	$\overline{RE} = 0V$
Receiver input to output, $t_{PLH}$	20	45	100	ns	$R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 7
Receiver input to output, $t_{PHL}$	20	45	100	ns	$R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 7
Differential receiver skew		13		ns	$ t_{PLH} - t_{PHL} $ ; $R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 7
Receiver enable to output LOW		45	70	ns	$C_{RL} = 15pF$ ; Figures 2 & 8; $S_1$ closed
Receiver enable to output HIGH		45	70	ns	$C_{RL} = 15pF$ ; Figures 2 & 8; $S_2$ closed
Receiver disable from LOW		45	70	ns	$C_{RL} = 15pF$ ; Figures 2 & 8; $S_1$ closed
Receiver disable from HIGH		45	70	ns	$C_{RL} = 15pF$ ; Figures 2 & 8; $S_2$ closed

Electrical Characteristics, Continued

T<sub>AMB</sub> = T<sub>MIN</sub> to T<sub>MAX</sub> and V<sub>CC</sub> = 5V ±5% unless otherwise noted

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Power Requirements					
Supply voltage	4.75		5.25	V	
Supply current		900		μA	$\overline{RE}$ , D = 0V or V <sub>CC</sub> ; DE = V <sub>CC</sub>
SP491E Environmental and Mechanical					
Operating Temperture					
Commercial (_C_)	0		70	°C	
Industrial (_E_)	-40		85	°C	
Storage Temperature	-65		150	°C	
Package					
NSOIC (_N)					

Switching Waveforms

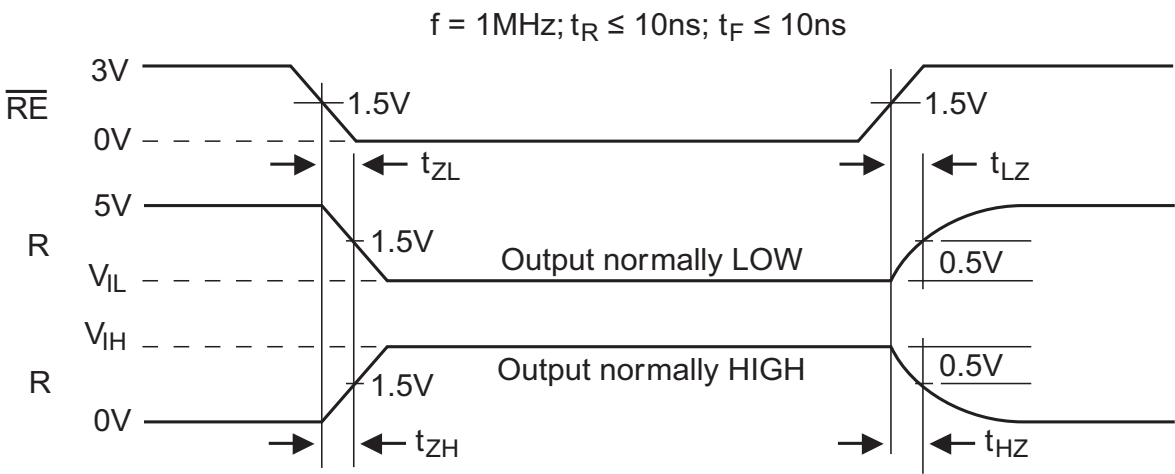
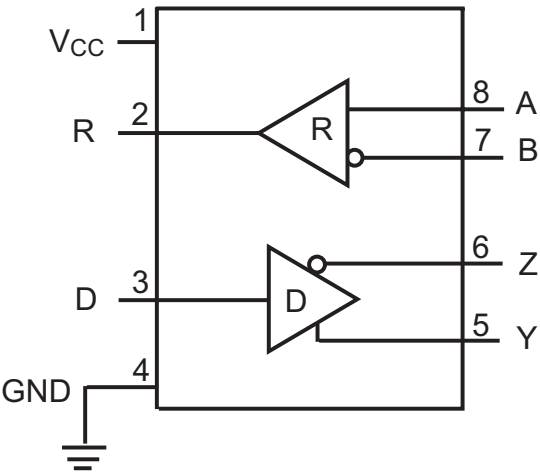


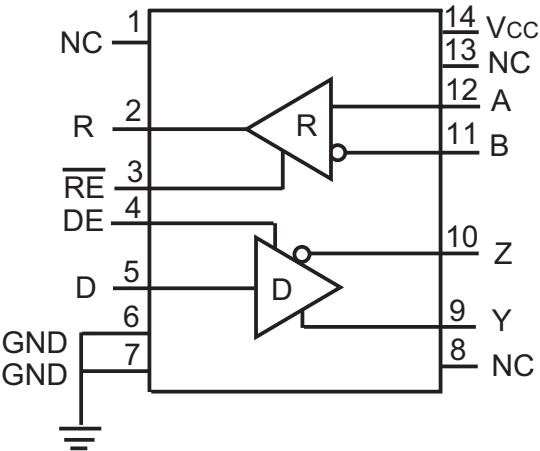
Figure 8: Receiver Enable and Disable Times

Pin Functions



SP490E  
Pinout (Top View)

Pin Number	Pin Name	Description
1	V <sub>CC</sub>	Positive supply
2	R	Receiver output
3	D	Driver Input
4	GND	Ground connection
5	Y	Non-inverting driver output
6	Z	Inverting driver output
7	B	Inverting receiver Input
8	A	Non-inverting receiver input



SP491E  
Pinout (Top View)

Pin Number	Pin Name	Description
1	NC	No connect
2	R	Receiver output
3	$\overline{RE}$	Receiver output enable active LOW
4	DE	Driver output enable active HIGH
5	D	Driver input
6	GND	Ground connection
7	GND	Ground connection
8	NC	No connect
9	Y	Non-inverting driver output
10	Z	Inverting driver output
11	B	Inverting receiver input
12	A	Non-Inverting receiver input
13	NC	No connect
14	V <sub>CC</sub>	Positive supply

## Description

The SP490E and SP491E are full-duplex differential transceivers that meet the requirements of RS-485 and RS-422. Fabricated with a MaxLinear 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.

### Drivers

The drivers for both the SP490E and SP491E 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 SP491E has a driver enable control line which is active high. A logic high on DE (pin 4) of the SP491E will enable the differential driver outputs. A logic low on DE (pin 4) of the SP491E will tri-state the driver outputs. The SP490E does not have a driver enable.

### Receivers

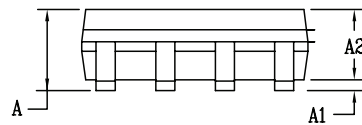
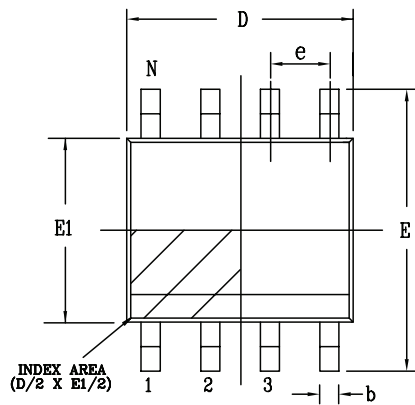
The receivers for both the SP490E and SP491E have differential inputs with an input sensitivity as low as  $\pm 200\text{mV}$ . Input impedance of the receivers is typically 15k $\Omega$  (12k $\Omega$  minimum). A wide common mode range of -7V to 12V allows for large ground potential differences between systems. The receivers for both the SP490E and SP491E 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 SP491E has a receiver enable control line which is active low. A logic low on  $\overline{\text{RE}}$  (pin 3) of the SP491E will enable the differential receiver. A logic high on  $\overline{\text{RE}}$  (pin 3) of the SP491E will tri-state the receiver.

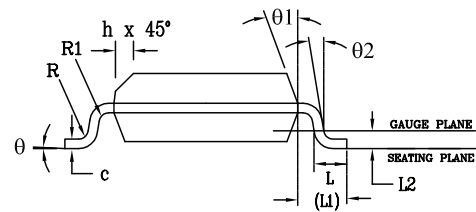
## Mechanical Dimensions

## NSOIC8

Top View



Side View



Front View

PACKAGE OUTLINE NSOIC .150" BODY JEDEC MS-012 VARIATION AA						
SYMBOLS	COMMON DIMENSIONS IN MM (Control Unit)			COMMON 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	—	—
q	0°	—	8°	0°	—	8°
q1	5°	—	15°	5°	—	15°
q2	0°	—	—	0°	—	—
D	4.90 BSC			0.193 BSC		
N	8					

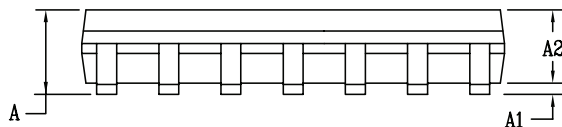
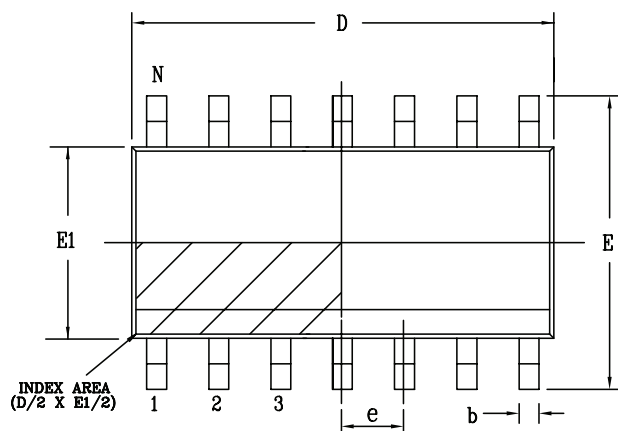
Drawing No: POD-00000108

Revision: A

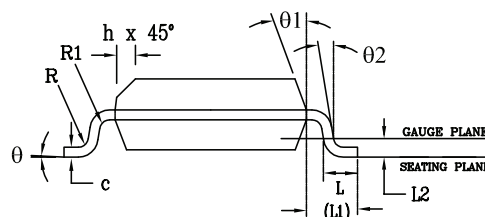
## Mechanical Dimensions

## NSOIC14

Top View



Side View



Front View

PACKAGE OUTLINE NSOIC .150" BODY JEDEC MS-012 VARIATION AB						
SYMBOLS	COMMON DIMENSIONS IN MM (Control Unit)			COMMON 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	—	—
q	0°	—	8°	0°	—	8°
q1	5°	—	15°	5°	—	15°
q2	0°	—	—	0°	—	—
D	8.65 BSC			0.341 BSC		
N	14					

Drawing No: POD-00000109

Revision: A

Ordering Information<sup>(1)</sup>

Part Number	Operating Temperature Range	Lead-Free	Package	Packaging Method
SP490ECN-L/TR	0°C to 70°C	Yes <sup>(2)</sup>	8-pin NSOIC	Reel
SP490EEN-L/TR	-40°C to 85°C			Reel
SP491ECN-L/TR	0°C to 70°C		14-pin NSOIC	Reel
SP491EEN-L/TR	-40°C to 85°C			Reel

## NOTE:

1. Refer to [www.exar.com/SP490E](http://www.exar.com/SP490E) and [www.exar.com/SP491E](http://www.exar.com/SP491E) for most up-to-date Ordering Information.

2. Visit [www.exar.com](http://www.exar.com) for additional information on Environmental Rating.

## Revision History

Revision	Date	Description
14	2000	Sipex Legacy Data Sheet
1.0.0	May 2011	Convert to Exar format. Remove driver propagation delay minimum and driver rise/fall time minimum entry for SP490E and SP491E. Update ESD rating to IEC61000-4-2. Update ordering information.
1.0.1	May 2013	Correct type errors per PCN 13-0503-01
1.0.2	February 2018	Updated to MaxLinear logo. Remove GND from Differential Output Voltage min (page 2 & 5). Update format and ordering information table. Added Pin Function section. Removed obsolete PDIP from description, mechanical and mechanical drawings.



## Corporate Headquarters:

5966 La Place Court  
Suite 100  
Carlsbad, CA 92008  
Tel.: +1 (760) 692-0711  
Fax: +1 (760) 444-8598  
[www.maxlinear.com](http://www.maxlinear.com)

## High Performance Analog:

1060 Rincon Circle  
San Jose, CA 95131  
Tel.: +1 (669) 265-6100  
Fax: +1 (669) 265-6101  
Email: [serialtechsupport@exar.com](mailto:serialtechsupport@exar.com)  
[www.exar.com](http://www.exar.com)

The content of this document is furnished for informational use only, is subject to change without notice, and should not be construed as a commitment by MaxLinear, Inc.. MaxLinear, Inc. assumes no responsibility or liability for any errors or inaccuracies that may appear in the informational content contained in this guide. Complying with all applicable copyright laws is the responsibility of the user. Without limiting the rights under copyright, no part of this document may be reproduced into, stored in, or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise), or for any purpose, without the express written permission of MaxLinear, Inc.

MaxLinear, Inc. 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 MaxLinear, Inc. receives, in writing, 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 MaxLinear, Inc. is adequately protected under the circumstances.

MaxLinear, Inc. may have patents, patent applications, trademarks, copyrights, or other intellectual property rights covering subject matter in this document. Except as expressly provided in any written license agreement from MaxLinear, Inc., the furnishing of this document does not give you any license to these patents, trademarks, copyrights, or other intellectual property.

Company and product names may be registered trademarks or trademarks of the respective owners with which they are associated.

© 2000 - 2017 MaxLinear, Inc. All rights reserved