SP490E / SP491E

Enhanced Full-Duplex RS-485 Transceivers

Description

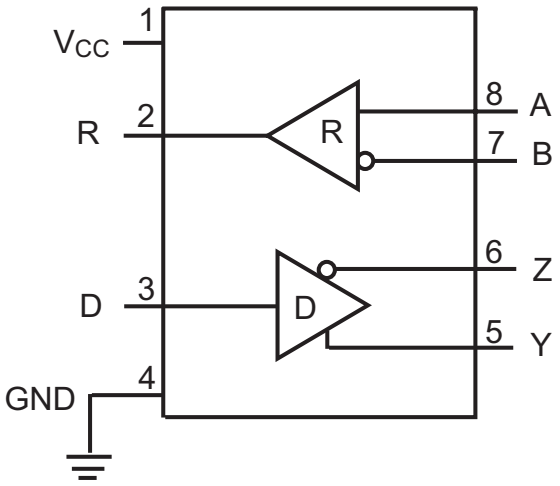
The SP490E is a low power differential line driver/receiver meeting RS-485 and RS-422 standards up to 10Mbps. The SP491E is identical to the SP490E with the addition of driver and receiver tri-state enable lines. Both products feature ±200mV receiver input sensitivity, over wide common mode range. The 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

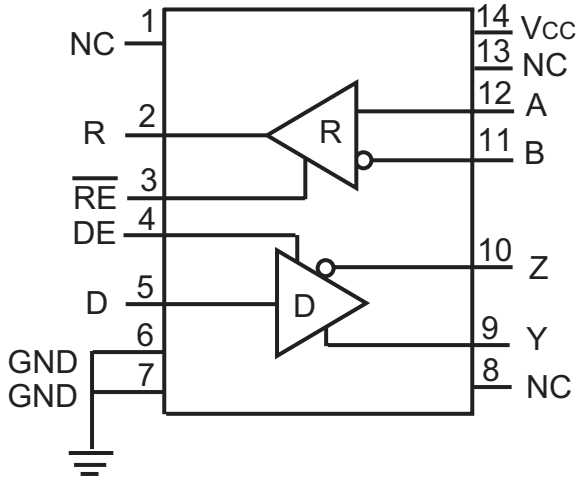
- 5V only
- Low power BiCMOS
- Driver/receiver enable (SP491E)
- RS-485 and RS-422 drivers/receivers
- Pin compatible with LTC490 and SN75179 (SP490E)
- Pin compatible with LTC491 and SN75180 (SP491E)
- Improved ESD specifications:
  - ±15kV Human Body Model
  - ±15kV IEC61000-4-2 Air Discharge

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.....±14V

Output Voltages

Drivers.....±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 ±5% unless otherwise noted.

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

Electrical Characteristics (Continued)

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP490E Receiver DC Characteristics					
Differential input threshold	-0.2		0.2	Volts	-7V ≤ V_{CM} ≤ 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		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			85	mA	0V ≤ V_O ≤ V_{CC}
SP490E Receiver AC Characteristics					
Maximum data rate	10			Mbps	
Receiver input to output, t_{PLH}	20	45	100	ns	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; Figures 3 and 7
Receiver input to output, t_{PHL}	20	45	100	ns	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; Figures 3 and 7
Differential receiver skew, $\|t_{PLH} - t_{PHL}\|$		13		ns	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; Figures 3 and 7
Power Requirements					
Supply Voltage	4.75		5.25	V	
Supply Current		900		µA	
SP490E Environmental and Mechanical					
Operating Temperture					
Commercial (_C_)	0		70	°C	
Industrial (_E_)	-40		85	°C	
Storage Temperature	-65		150	°C	
Package					
NSOIC (_N)					

Test Circuits

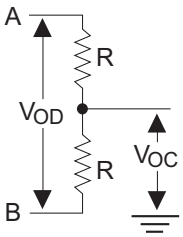


Figure 1: Driver DC Test Load Circuit

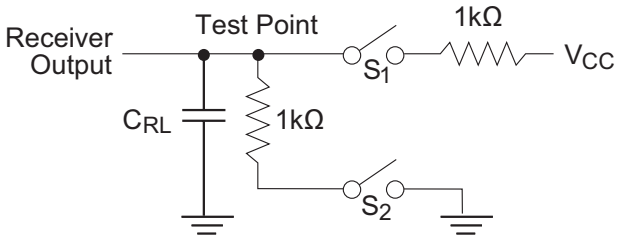


Figure 2: Receiver Timing Test Load Circuit

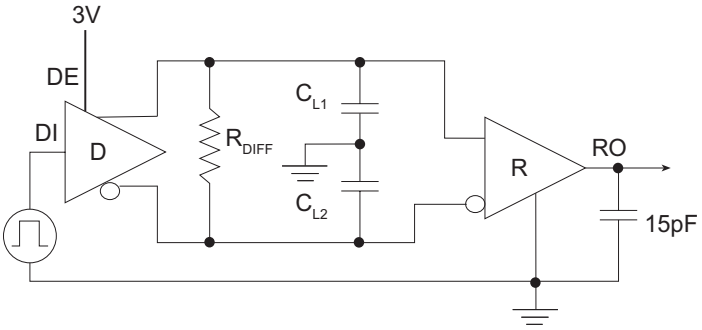


Figure 3: Driver/Receiver Timing Test Circuit

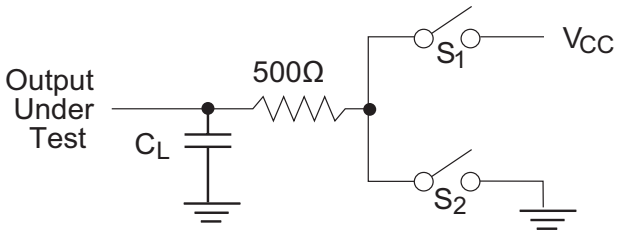


Figure 4: Driver Timing Test Load #2 Circuit

Switching Waveforms

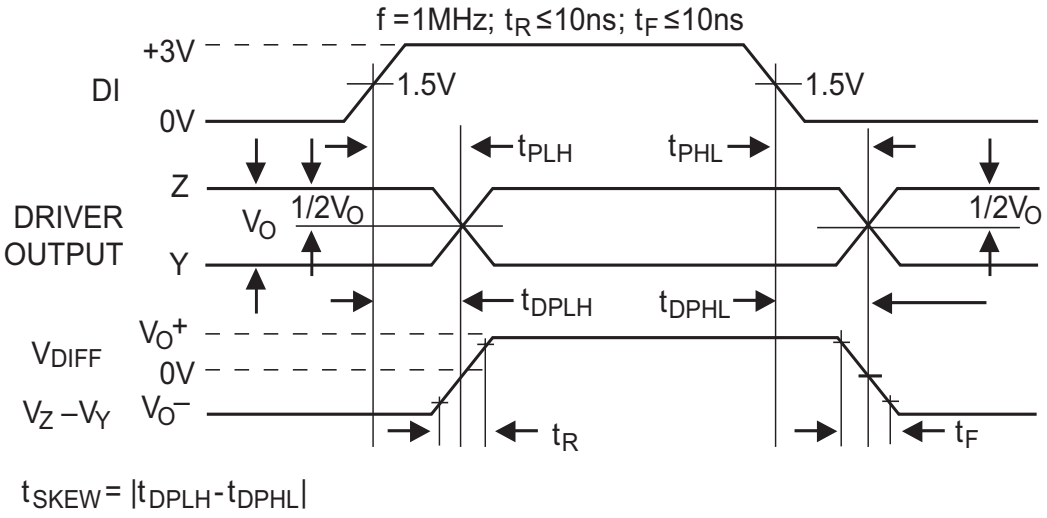


Figure 5: Driver Propagation Delays

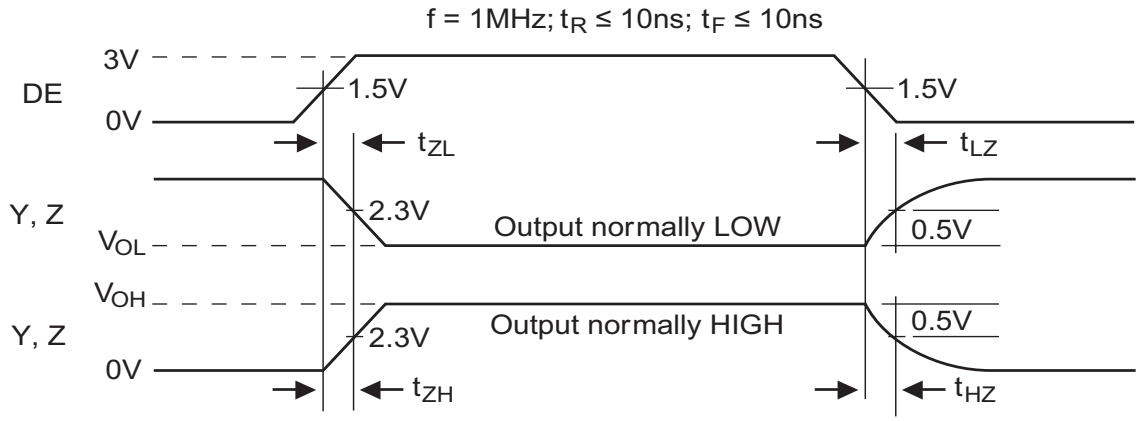


Figure 6: Driver Enable and Disable Times

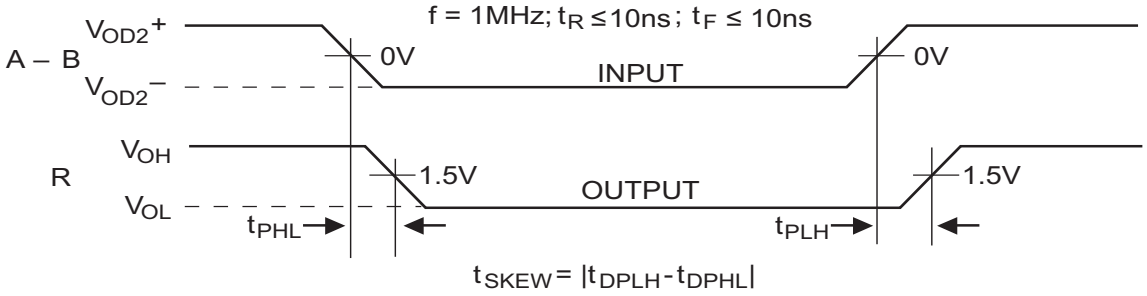


Figure 7: Receiver Propagation Delays

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.....±14V

Output Voltages

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

Drivers.....±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 ±5% unless otherwise noted

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP491E Driver DC Characteristics					
Differential output voltage			V_{CC}	V	Unloaded; R = ∞Ω; Figure 1
Differential output voltage	2		V_{CC}	V	With load; R = 50Ω (RS-422); Figure 1
Differential output voltage	1.5		V_{CC}	V	With load; R = 27Ω (RS-485); Figure 1
Change in magnitude of driver differential output voltage for complimentary states			0.2	V	R = 27Ω or R = 50Ω; Figure 1
Driver common-mode output voltage			3	V	R = 27Ω or R = 50Ω; 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			±10	µA	Applies to DE, D, $\overline{RE}$
Driver short circuit current V_{OUT} = HIGH			±250	mA	-7V ≤ V_O ≤ 12V
Driver short circuit current V_{OUT} = LOW			±250	mA	-7V ≤ V_O ≤ 12V

Electrical Characteristics (Continued)

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP491E Driver AC Characteristics					
Maximum data rate	10			Mbps	$\overline{RE}$ = 5V, DE = 5V
Driver input to output, t_{PLH}		30	60	ns	R_{DIFF} = 54Ω, $C_{L1} = C_{L2}$ = 100pF; Figures 3 & 5
Driver input to output, t_{PHL}		30	60	ns	R_{DIFF} = 54Ω, $C_{L1} = C_{L2}$ = 100pF; Figures 3 & 5
Driver skew		5	10	ns	$t_{SKEW} = \lvert t_{DPLH} - t_{DPHL} \rvert$; Figures 3 & 5
Driver rise or fall time		15	40	ns	From 10%-90%; R_{DIFF} = 54Ω, $C_{L1} = C_{L2}$ = 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
SP491E Receiver DC Characteristics					
Differential input threshold	-0.2		0.2	Volts	-7V ≤ V_{CM} ≤ 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			±1	µA	0.4V ≤ V_O ≤ 2.4V; $\overline{RE}$ = 5V
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 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 ≤ V_O ≤ V_{CC}
SP491E Receiver AC Characteristics					
Maximum data rate	10			Mbps	$\overline{RE}$ = 0V
Receiver input to output, t_{PLH}	20	45	100	ns	R_{DIFF} = 54Ω, $C_{L1} = C_{L2}$ = 100pF; Figures 3 & 7
Receiver input to output, t_{PHL}	20	45	100	ns	R_{DIFF} = 54Ω, $C_{L1} = C_{L2}$ = 100pF; Figures 3 & 7
Differential receiver skew		13		ns	$\lvert t_{PLH} - t_{PHL} \rvert$; R_{DIFF} = 54Ω, $C_{L1} = C_{L2}$ = 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

$T_{AMB} = T_{MIN}$ to T_{MAX} and V_{CC} = 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_{CC}; DE = V_{CC}
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

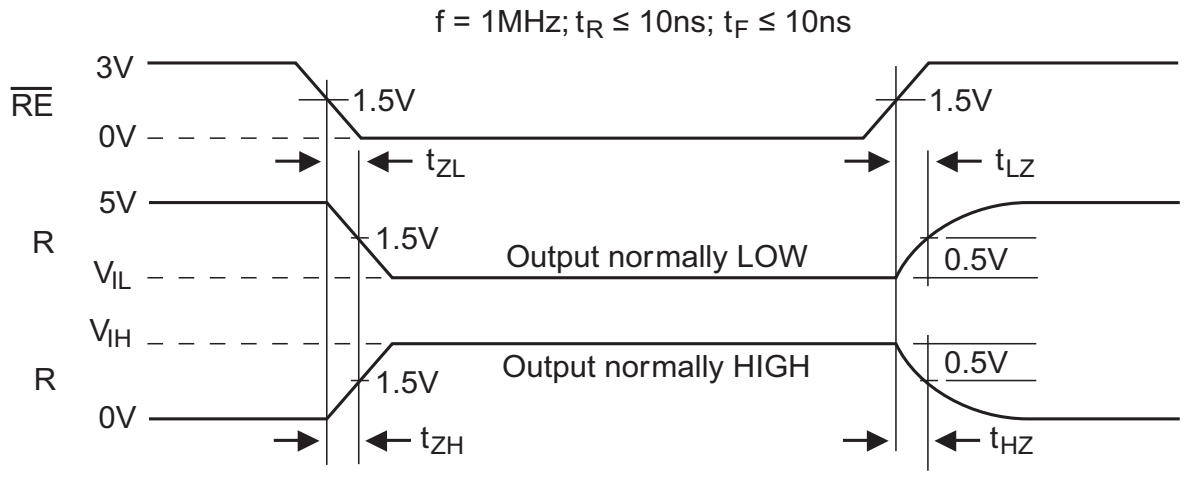
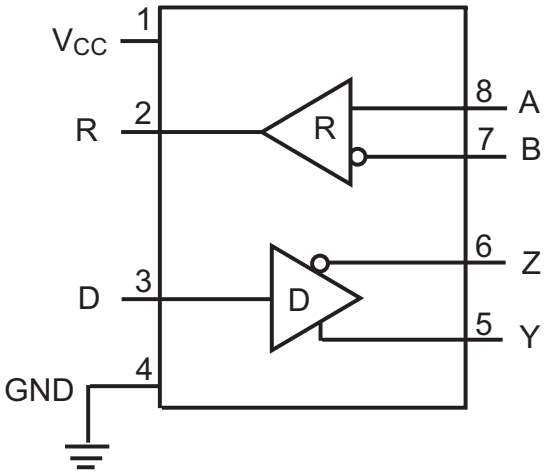


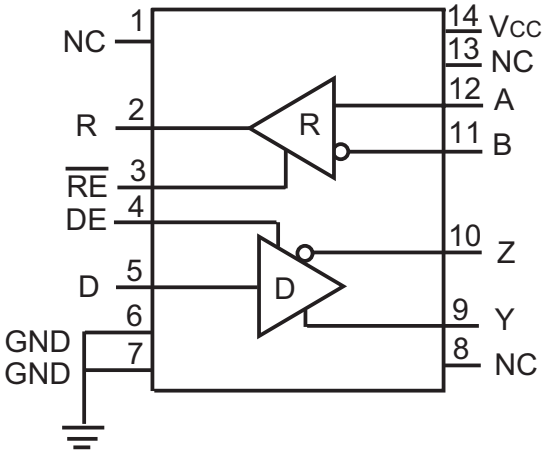
Figure 8: Receiver Enable and Disable Times

Pin Functions



SP490E
Pinout (Top View)

Pin Number	Pin Name	Description
1	V_{CC}	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_{CC}	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 54Ω 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

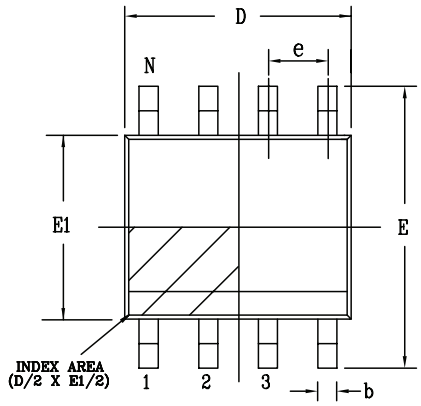
The receivers for both the SP490E and SP491E have differential inputs with an input sensitivity as low as ±200mV. Input impedance of the receivers is typically 15kΩ (12kΩ minimum). A wide common mode range of -7V to 12V allows for large ground potential differences between systems. The receivers for both the 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.

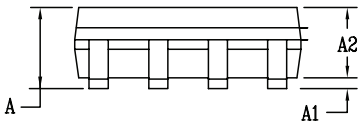
The receiver of the SP491E has a receiver enable control line which is active low. A logic low on $\overline{RE}$ (pin 3) of the SP491E will enable the differential receiver. A logic high on $\overline{RE}$ (pin 3) of the SP491E will tri-state the receiver.

Mechanical Dimensions

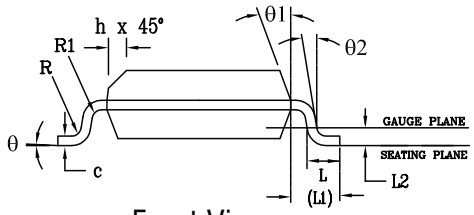
NSOIC8

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					

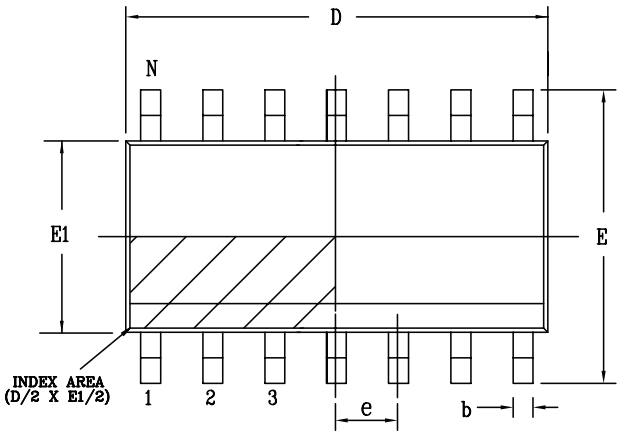
Drawing No: POD-00000108

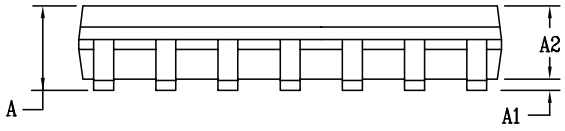
Revision: A

Mechanical Dimensions

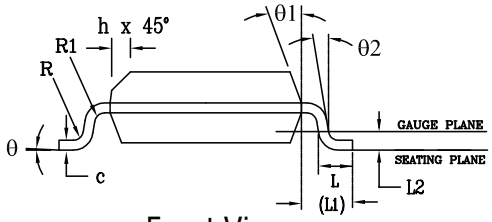
NSOIC14

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[1]

Part Number	Operating Temperature Range	Lead-Free	Package	Packaging Method
SP490ECN-L/TR	0°C to 70°C	Yes[2]	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 and www.exar.com/SP491E for most up-to-date Ordering Information.
2. Visit 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.

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