

## Full Duplex RS-485 Transceivers

### FEATURES

- +5V Only
- Low Power BiCMOS
- Driver/Receiver Enable (**SP491**)
- RS-485 and RS-422 Drivers/Receivers
- Pin Compatible with LTC490 and SN75179 (**SP490**)
- Pin Compatible with LTC491 and SN75180 (**SP491**)

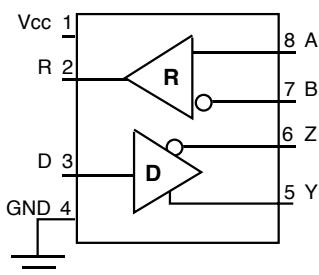
*Now Available in Lead Free Packaging*



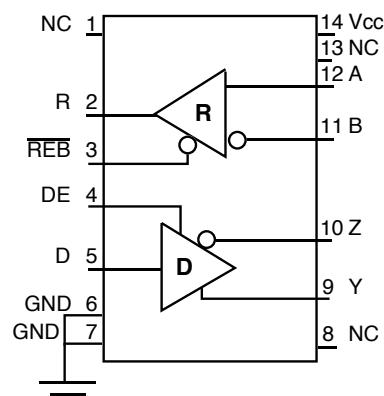
### DESCRIPTION

The **SP490** is a low power differential line driver/receiver meeting RS-485 and RS-422 standards up to 5Mbps. The **SP491** is identical to the **SP490** 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 **SP490** is available in 8-pin plastic DIP and 8-pin NSOIC packages for operation over the commercial and industrial temperature ranges. The **SP491** is available in 14-pin DIP and 14-pin NSOIC packages for operation over the commercial and industrial temperature ranges.

### BLOCK DIAGRAMS



**SP490**



**SP491**

## 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.

$V_{CC}$	.....	+7V
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		
Power Dissipation	.....	1000mW

## ELECTRICAL CHARACTERISTICS

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>SP490 DRIVER</b>					
<b>DC Characteristics</b>					
Differential Output Voltage	GND			$V_{CC}$	Volts
Differential Output Voltage	2			$V_{CC}$	Volts
Differential Output Voltage	1.5			$V_{CC}$	Volts
Change in Magnitude of Driver					
Differential Output Voltage for					
Complimentary States			0.2	Volts	$R = 27\Omega$ or $R = 50\Omega$ ; <i>see figure 1</i>
Driver Common-Mode					
Output Voltage			3	Volts	$R = 27\Omega$ or $R = 50\Omega$ ; <i>see figure 1</i>
Input High Voltage					Applies to D
Input Low Voltage			0.8	Volts	Applies to D
Input Current			±10	Volts	Applies to D
Driver Short-Circuit Current					
$V_{OUT} = \text{HIGH}$	35		250	mA	$-7V \leq V_O \leq +12V$
$V_{OUT} = \text{LOW}$	35		250	mA	$-7V \leq V_O \leq +12V$
<b>SP490 DRIVER</b>					
<b>AC Characteristics</b>					
Maximum Data Rate	5			Mbps	
Driver Input to Output		30	60	ns	$t_{PLH}; R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100\text{pF}$ ; <i>see figures 3 and 6</i>
Driver Input to Output		30	60	ns	$t_{PHL}; R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100\text{pF}$ ; <i>see figures 3 and 6</i>
Driver Skew		5		ns	<i>see figures 3 and 6</i> ,
Driver Rise or Fall Time		15	40	ns	$t_{SKEW} =  t_{DPLH} - t_{DPHL} $ From 10% to 90%; $R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100\text{pF}$ ; <i>see figures 3 and 6</i>
<b>SP490 RECEIVER</b>					
<b>DC Characteristics</b>					
Differential Input Threshold	0.2			+0.2	Volts
Input Hysteresis					$V_{CM} = 0V$
Output Voltage High	3.5	70			$I_O = -4\text{mA}, V_{ID} = +200\text{mV}$
Output Voltage Low			0.4	Volts	$I_O = +4\text{mA}, V_{ID} = -200\text{mV}$
Input Resistance	12				$-7V \leq V_{CM} \leq 12V$
Input Current (A, B); $V_{IN} = 12V$			±1.0	kΩ	$V_{IN} = 12V$
Input Current (A, B); $V_{IN} = -7V$			-0.8	mA	$V_{IN} = -7V$
Short-Circuit Current			85	mA	$0V \leq V_O \leq V_{CC}$

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>SP490 RECEIVER</b>					
<b>AC Characteristics</b>					
Maximum Data Rate	5	90	150	Mbps	
Receiver Input to Output				ns	$t_{PLH}; R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 8
Receiver Input to Output		90	150	ns	$t_{PHL}; R_{DIFF} = 54\Omega$ , $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 8
Diff. Receiver Skew $t_{PLH} - t_{PHL}$		13		ns	$R_{DIFF} = 54\Omega$ ; $C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 8
<b>POWER REQUIREMENTS</b>					
Supply Voltage	+4.75			+5.25	Volts
Supply Current		900		$\mu A$	
<b>ENVIRONMENTAL AND MECHANICAL</b>					
Operating Temperature					
Commercial (_C_)	0		+70	$^{\circ}C$	
Industrial (_E_)	-40		+85	$^{\circ}C$	
Storage Temperature			+150	$^{\circ}C$	
Package					
Plastic DIP (_S_)					
NSOIC (_N)					

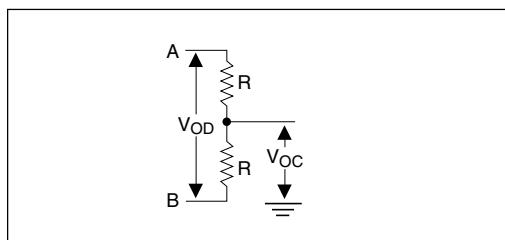


Figure 1. Driver DC Test Load Circuit

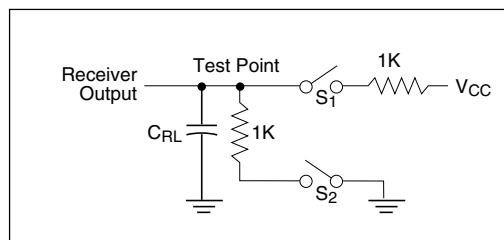


Figure 2. Receiver Timing Test Load Circuit

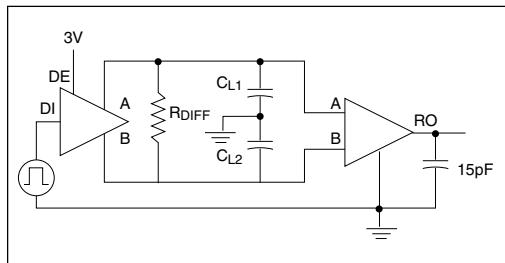


Figure 3. Driver/Receiver Timing Test Circuit

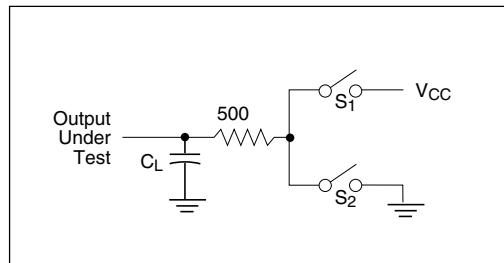


Figure 4. Driver Timing Test Load #2 Circuit

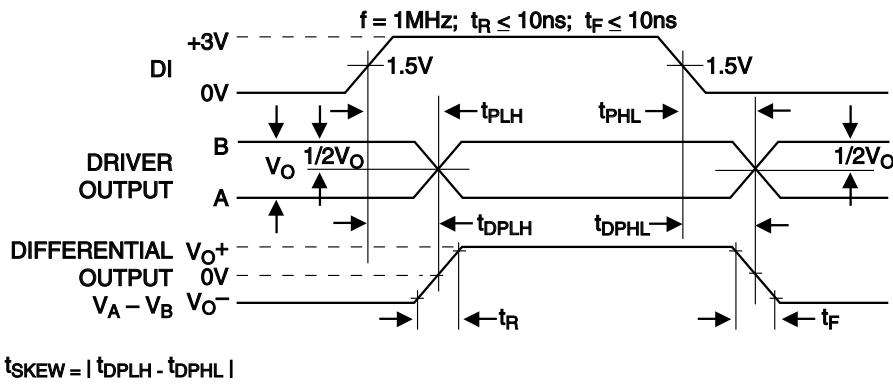


Figure 6. Driver Propagation Delays

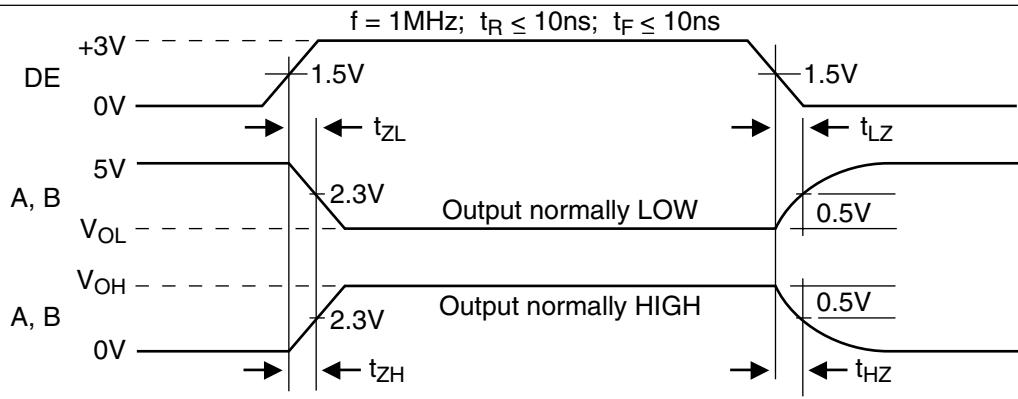


Figure 7. Driver Enable and Disable Times

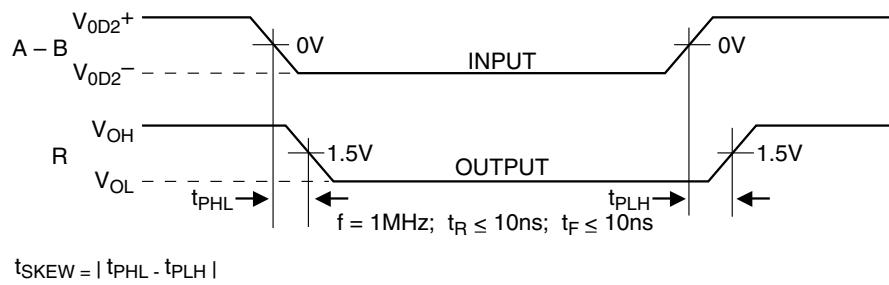


Figure 8. Receiver Propagation Delays

## 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> .....	+7V
Input Voltages	
Logic.....	-0.5V to (V <sub>CC</sub> +0.5V)
Drivers.....	-0.5V to (V <sub>CC</sub> +0.5V)
Receivers.....	±14V
Output Voltages	
Logic.....	-0.5V to (V <sub>CC</sub> +0.5V)
Drivers.....	±14V
Receivers.....	-0.5V to (V <sub>CC</sub> +0.5V)
Storage Temperature.....	-65°C to +150
Power Dissipation.....	1000mW

## ELECTRICAL CHARACTERISTICS

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
<b>SP491 DRIVER</b>					
<b>DC Characteristics</b>					
Differential Output Voltage	GND		V <sub>CC</sub>	Volts	Unloaded; R = ∞ ; see figure 1
Differential Output Voltage	2		V <sub>CC</sub>	Volts	With Load; R = 50Ω; (RS422); see figure 1
Differential Output Voltage	1.5		V <sub>CC</sub>	Volts	With Load; R = 27Ω; (RS485); see figure 1
Change in Magnitude of Driver					
Differential Output Voltage for			0.2	Volts	R = 27Ω or R = 50Ω; see figure 1
Complementary States					
Driver Common-Mode					
Output Voltage	2.0		3	Volts	R = 27Ω or R = 50Ω; see figure 1
Input High Voltage					Applies to D, R <sub>EB</sub> , DE
Input Low Voltage			0.8	Volts	Applies to D, R <sub>EB</sub> , DE
Input Current			±10	Volts	Applies to D, R <sub>EB</sub> , DE
Driver Short-Circuit Current			250	mA	-7V ≤ V <sub>O</sub> ≤ 12V
V <sub>OUT</sub> = HIGH	35		250	mA	-7V ≤ V <sub>O</sub> ≤ 12V
V <sub>OUT</sub> = LOW	35				
<b>SP491 DRIVER</b>					
<b>AC Characteristics</b>					
Maximum Data Rate	5			Mbps	R <sub>EB</sub> = 5V, DE = 5V
Driver Input to Output	20	30	60	ns	t <sub>PLH</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 and 6
Driver Input to Output	20	30	60	ns	t <sub>PHL</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 and 6
Driver Skew		5	10	ns	see figures 3 and 6, t <sub>SKEW</sub> =   t <sub>DPLH</sub> - t <sub>DPHL</sub>
Driver Rise or Fall Time	3	15	40	ns	From 10% to 90%; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 and 6
Driver Enable to Output High		40	70	ns	C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 4 and 7; S <sub>2</sub> closed
Driver Enable to Output Low		40	70	ns	C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 4 and 7; S <sub>2</sub> closed
Driver Disable Time from Low		40	70	ns	C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 4 and 7; S <sub>1</sub> closed
Driver Disable Time from High		40	70	ns	C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 4 and 7; S <sub>2</sub> closed

## ELECTRICAL CHARACTERISTICS

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>SP491 RECEIVER</b>					
<b>DC Characteristics</b>					
Differential Input Threshold	-0.2	70	+0.2	Volts	$-7V \leq V_{CM} \leq 12V$
Input Hysteresis	3.5		0.4	mV	$V_{CM} = 0V$
Output Voltage High				Volts	$I_O = -4mA, V_{ID} = +200mV$
Output Voltage Low				Volts	$I_O = +4mA, V_{ID} = -200mV$
Three State (high impedance)					
Output Current	12	15	$\pm 1$	$\mu A$	$0.4V \leq V_O \leq 2.4V; \overline{REB} = 5V$
Input Resistance				$k\Omega$	$-7V \leq V_{CM} \leq 12V$
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	7		85	mA	$0V \leq V_O \leq V_{CC}$
<b>SP491 RECEIVER</b>					
<b>DC Characteristics</b>					
Maximum Data Rate	5	90	150	Mbps	$\overline{REB} = 0V$
Receiver Input to Output	60			ns	$t_{PLH}; R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 8
Receiver Input to Output	60	90	150	ns	$t_{PHL}; R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 8
Diff. Receiver Skew $t_{PLH} - t_{PHL}$		13		ns	$R_{DIFF} = 54\Omega; C_{L1} = C_{L2} = 100pF$ ; Figures 3 & 8
Receiver Enable to Output Low	20		50	ns	$C_{RL} = 15pF$ ; Figures 2 and 9; $S_1$ closed
Receiver Enable to Output High	20		50	ns	$C_{RL} = 15pF$ ; Figures 2 and 9; $S_2$ closed
Receiver Disable from Low	20		50	ns	$C_{RL} = 15pF$ ; Figures 2 and 9; $S_1$ closed
Receiver Disable from High	20		50	ns	$C_{RL} = 15pF$ ; Figures 2 and 9; $S_2$ closed
<b>POWER REQUIREMENTS</b>					
Supply Voltage	+4.75	600	+5.25	Volts	$\overline{REB}, D = 0V$ or $V_{CC}$ ; $DE = V_{CC}$
Supply Current				$\mu A$	
<b>SP491 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					
Plastic DIP ( $_S$ )					
NSOIC ( $_N$ )					

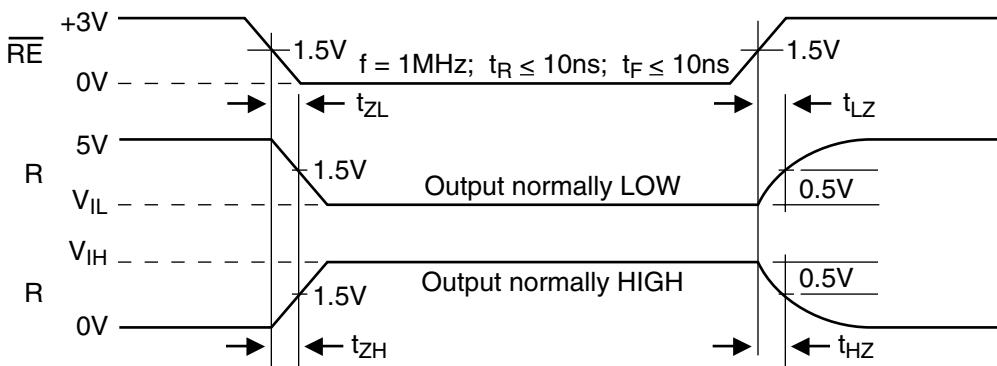


Figure 9. Receiver Enable and Disable Times

## DESCRIPTION

The **SP490** and **SP491** are full-duplex differential transceivers that meet the requirements of RS-485 and RS-422. Fabricated with a **Sipex** 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.

### Driver...

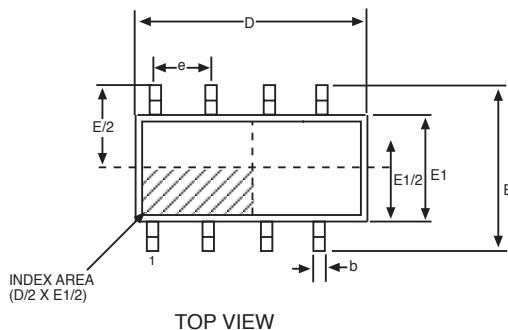
The drivers for both the **SP490** and **SP491** have differential outputs. The typical voltage output swing with no load will be 0 volts to +5 volts. With worst case loading of  $54\Omega$  across the differential outputs, the driver can maintain greater than 1.5V voltage levels.

The driver of the **SP491** has a driver enable control line which is active high. A logic high on DE (pin 4) of the **SP491** will enable the differential driver outputs. A logic low on DE (pin 4) of the **SP491** will tri-state the driver outputs. The **SP490** does not have a driver enable.

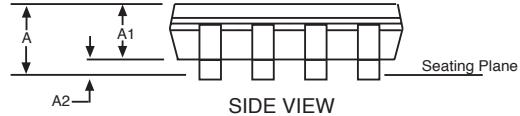
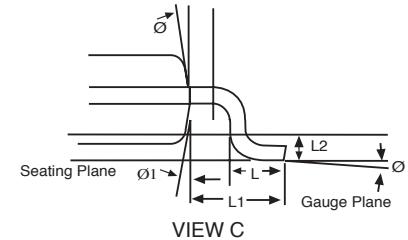
### Receiver...

The receivers for both the **SP490** and **SP491** have differential inputs with an input sensitivity as low as  $\pm 200\text{mV}$ . 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 **SP490** and **SP491** 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 **SP491** has a receiver enable control line which is active low. A logic low on  $\overline{\text{REB}}$  (pin 3) of the **SP491** will enable the differential receiver. A logic high on  $\overline{\text{REB}}$  (pin 3) of the **SP491** will tri-state the receiver.

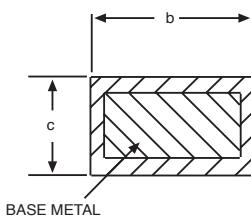
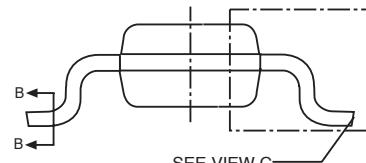


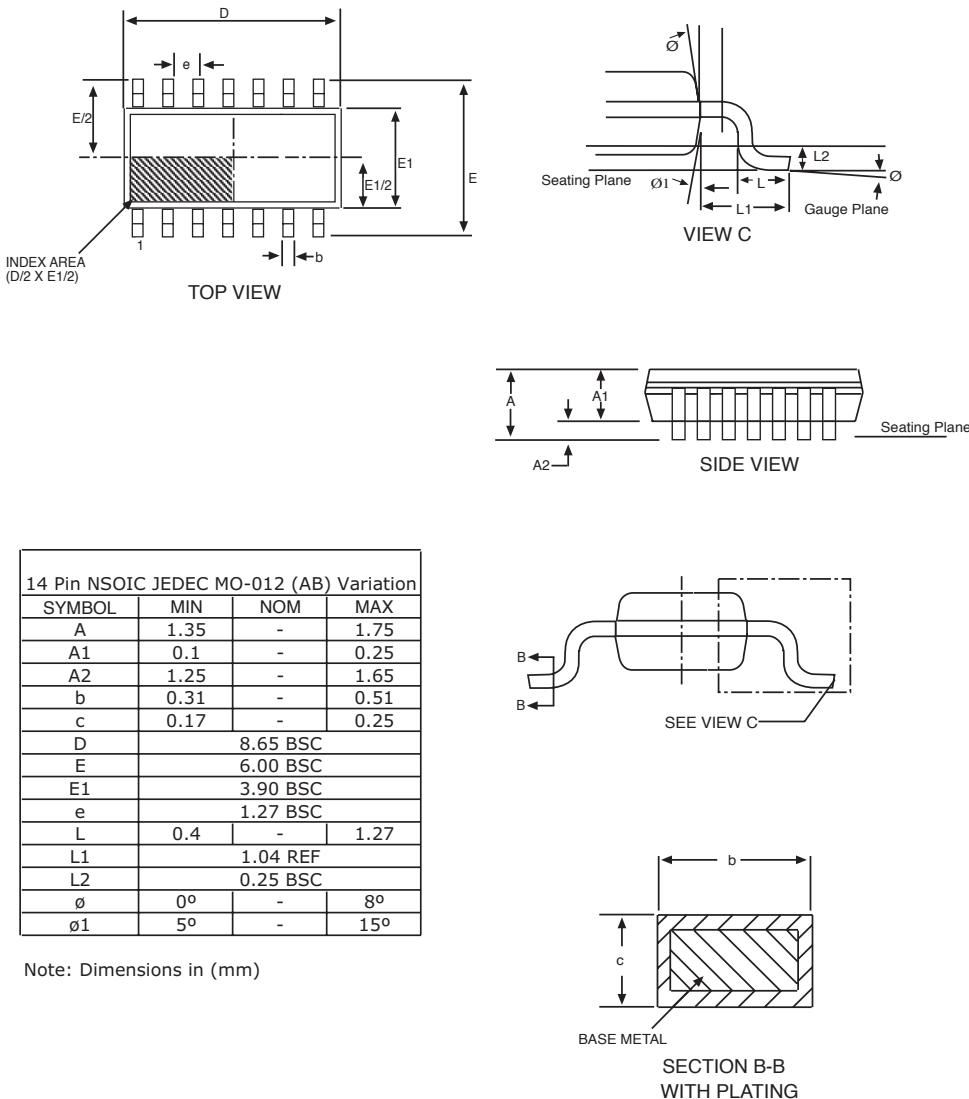
TOP VIEW

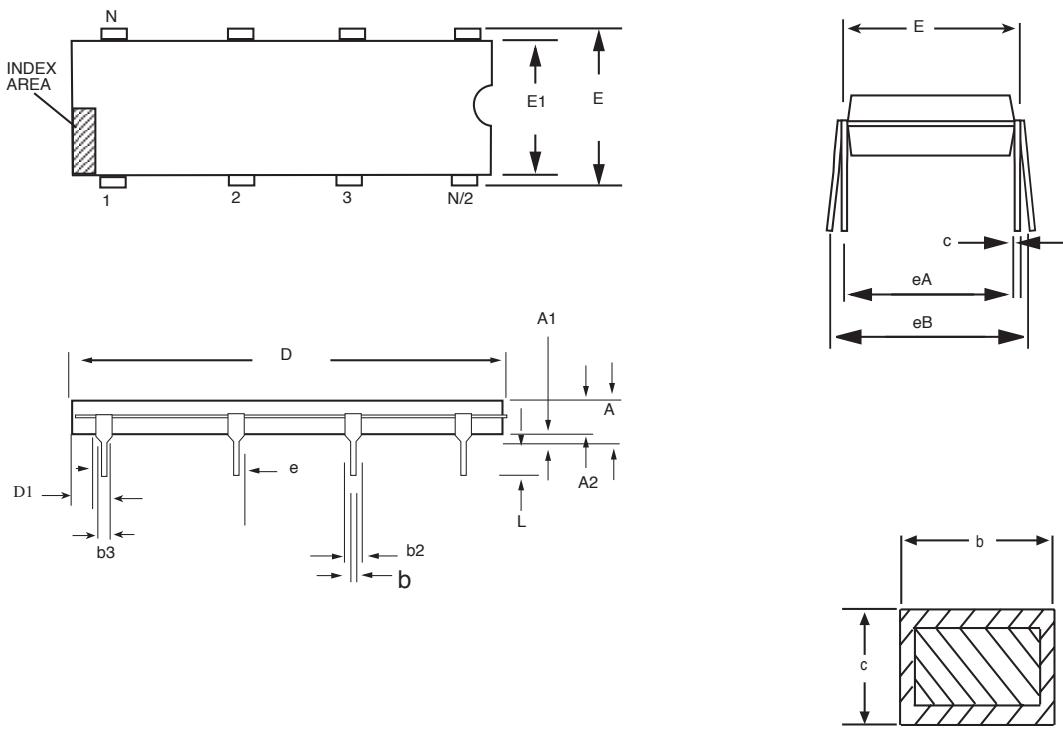


8 Pin NSOIC JEDEC MO-012 (AA) Variation			
SYMBOL	MIN	NOM	MAX
A	1.35	-	1.75
A1	0.1	-	0.25
A2	1.25	-	1.65
b	0.31	-	0.51
c	0.17	-	0.24
D	4.90 BSC		
E	6.00 BSC		
E1	3.90 BSC		
e	1.27 BSC		
L	0.4	-	1.27
L1	1.04 REF		
L2	0.25 BSC		
Ø	0°	-	8°
Ø1	5°	-	15°

Note: Dimensions in (mm)

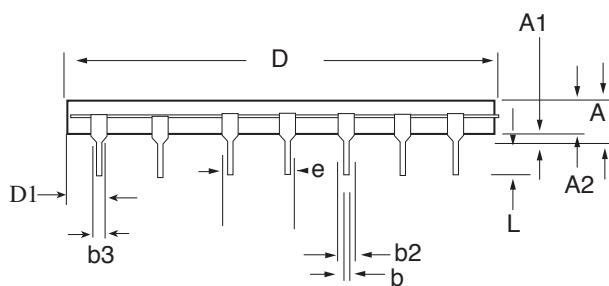
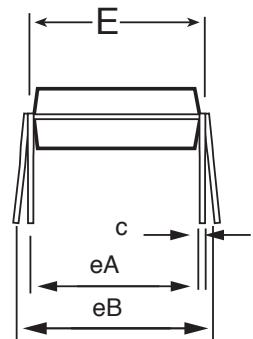
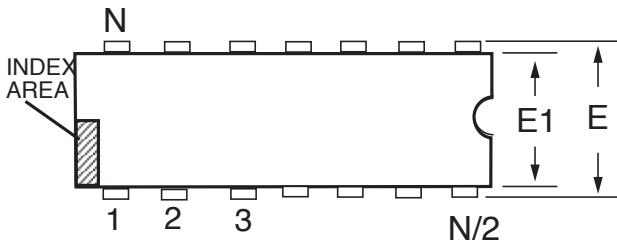

 SECTION B-B  
WITH PLATING





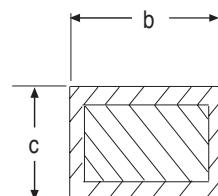
8 PIN PDIP JEDEC MS-001 (BA) Variation			
SYMBOL	MIN	NOM	MAX
A	-	-	0.21
A1	0.15	-	-
A2	0.115	0.13	0.195
b	0.014	0.018	0.022
b2	0.045	0.06	0.07
b3	0.3	0.039	0.045
c	0.008	0.01	0.014
D	0.355	0.365	0.4
D1	0.005	-	-
E	0.3	0.31	0.325
E1	0.24	0.25	0.28
e	.100 BSC		
eA	.300 BSC		
eB	-	-	0.43
L	0.115	0.13	0.15

Note: Dimensions in (mm)



14 PIN PDIP JEDEC MS-001 (AA) Variation			
SYMBOL	MIN	NOM	MAX
A	-	-	0.21
A1	0.15	-	-
A2	0.115	0.13	0.195
b	0.014	0.018	0.022
b2	0.045	0.06	0.07
b3	0.3	0.039	0.045
c	0.008	0.01	0.014
D	0.735	0.75	0.755
D1	0.005	-	-
E	0.3	0.31	0.325
E1	0.24	0.25	0.28
e	.100 BSC		
eA	.300 BSC		
eB	-	-	0.43
L	0.115	0.13	0.15

Note: Dimensions in (mm)



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## ORDERING INFORMATION

Model	Temperature Range	Package
SP490CN.....	0°C to +70°C .....	8-Pin NSOIC
SP490CN/TR.....	0°C to +70°C .....	8-Pin NSOIC
SP490CS.....	0°C to +70°C .....	8-Pin PDIP
SP490EN.....	-40°C to +85°C .....	8-Pin NSOIC
SP490EN/TR.....	-40°C to +85°C .....	8-Pin NSOIC
SP490ES.....	-40°C to +85°C .....	8-Pin PDIP
SP491CN.....	0°C to +70°C .....	14-Pin NSOIC
SP491CN/TR.....	0°C to +70°C .....	14-Pin NSOIC
SP491CS.....	0°C to +70°C .....	14-Pin PDIP
SP491EN.....	-40°C to +85°C .....	14-Pin NSOIC
SP491EN/TR.....	-40°C to +85°C .....	14-Pin NSOIC
SP491ES.....	-40°C to +85°C .....	14-Pin PDIP

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SP491CN/TR = standard; SP491CN-L/TR = lead free

/TR = Tape and Reel

Pack quantity is 2500 for NSOIC.

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→ ***CLICK HERE TO ORDER SAMPLES*** ←

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**Sipex Corporation**

**Headquarters and Sales Office**  
233 South Hillview Drive  
Milpitas, CA 95035  
TEL: (408) 934-7500  
FAX: (408) 935-7600

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