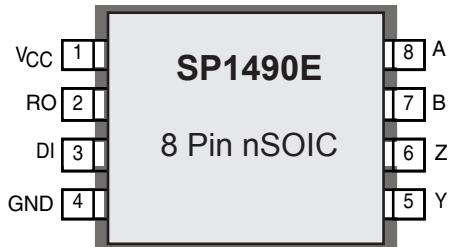


## Full Duplex RS-485 Transceivers

### FEATURES

- +5V Only
- Low Power BiCMOS
- Driver/Receiver Enable (SP1491E)
- RS-485 and RS-422 Drivers/Receivers
- Pin Compatible with SN75179 (SP1490E)
- Pin Compatible with SN75180 (SP1491E)
- Improved ESD Specifications  
±15kV Human Body Model  
±15kV IEC61000-4-2 Air Discharge



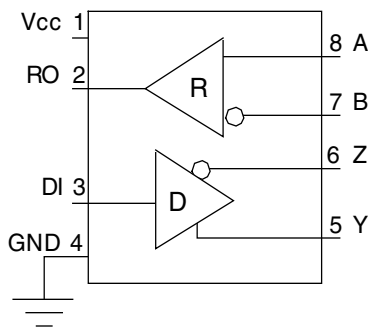
### APPLICATIONS

- Industrial Networks
- Telecom
- Motor Control
- HVAC/ Building Control

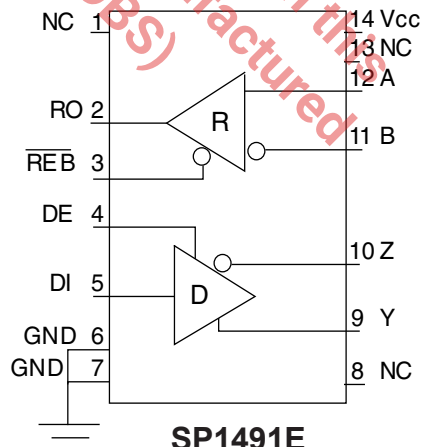
### DESCRIPTION

The SP1490E is a low power differential line driver/receiver meeting RS-485 and RS-422 standards up to 20Mbps. The SP1491E is identical to the SP1490E with the addition of driver and receiver tri-state enable lines. Both products feature  $\pm 200\text{mV}$  receive input sensitivity, over wide common mode range. The SP1490E is available in an 8-pin NSOIC packages for operation over the commercial and industrial temperature ranges. The SP1491E is available in a 14-pin NSOIC packages for operation over the commercial and industrial temperature ranges.

### BLOCK DIAGRAM



**SP1490E**



**SP1491E**

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

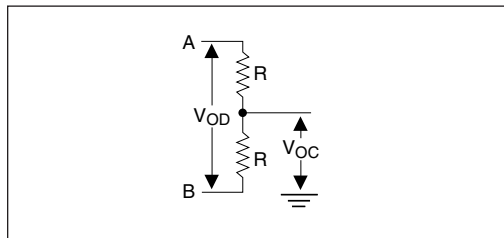
## ELECTRICAL CHARACTERISTICS

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

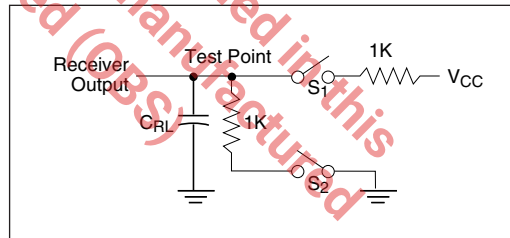
| PARAMETERS                                                                         | MIN. | TYP. | MAX.            | UNITS | CONDITIONS                                                                                                 |
|------------------------------------------------------------------------------------|------|------|-----------------|-------|------------------------------------------------------------------------------------------------------------|
| <b>SP1490E/1491E DRIVER</b>                                                        |      |      |                 |       |                                                                                                            |
| <b>DC Characteristics</b>                                                          |      |      |                 |       |                                                                                                            |
| Differential Output Voltage                                                        | 3.5  |      | 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 figure 1                                               | 1.5  |      | V <sub>CC</sub> | Volts | With Load; R = 27Ω; (RS485); see                                                                           |
| Change in Magnitude of Driver Differential Output Voltage for Complimentary States |      | 0.2  |                 | Volts | R = 27Ω or R = 50Ω; see figure 1                                                                           |
| Driver Common-Mode Output Voltage                                                  |      | 3    |                 | Volts | R = 27Ω or R = 50Ω; see figure 1                                                                           |
| Input High Voltage                                                                 | 2.0  |      |                 | Volts | Applies to D                                                                                               |
| Input Low Voltage                                                                  |      | 0.8  |                 | Volts | Applies to D                                                                                               |
| Input Current                                                                      |      | ±10  |                 | μA    | Applies to D                                                                                               |
| Driver Short-Circuit Current                                                       |      |      | ±250            | mA    | 7V ≤ V <sub>O</sub> ≤ +12V                                                                                 |
| V <sub>OUT</sub> = HIGH                                                            |      |      | ±250            | mA    | -7V ≤ V <sub>O</sub> ≤ +12V                                                                                |
| V <sub>OUT</sub> = LOW                                                             |      |      |                 |       |                                                                                                            |
| <b>SP1490E/1491E DRIVER</b>                                                        |      |      |                 |       |                                                                                                            |
| <b>AC Characteristics</b>                                                          |      |      |                 |       |                                                                                                            |
| Maximum Data Rate                                                                  | 20   |      |                 | Mbps  |                                                                                                            |
| Driver Input to Output                                                             |      | 30   | 40              | ns    | t <sub>R/F</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 and 6 |
| Driver Input to Output                                                             |      | 30   | 40              | ns    | t <sub>R/F</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 and 6 |
| Driver Skew                                                                        |      |      | 5               | ns    | see figures 3 and 6,                                                                                       |
| Driver Rise or Fall Time                                                           |      | 8    | 20              | ns    | t <sub>R/F</sub> =  t <sub>PLH</sub> - t <sub>PHL</sub>  <br>From 10% to 90%; R <sub>DIFF</sub> = 54Ω,     |
| <b>SP1491E only</b>                                                                |      |      |                 |       |                                                                                                            |
| Driver Enable to Output High                                                       |      | 20   | 70              | ns    | C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 and 6                                             |
| Driver Enable to Output Low                                                        |      | 40   | 70              | ns    | t <sub>R/F</sub><br>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>1</sub> closed                      |

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

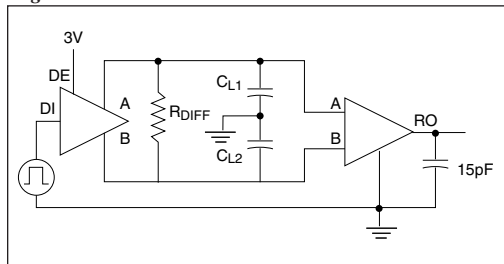
| SP1490E/1491E RECEIVER                                  |       |      |       |       |                                                 |                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------|-------|------|-------|-------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DC Characteristics                                      |       |      |       |       |                                                 |                                                                                                                                                                                                                                                                                           |
| Differential Input Threshold                            | 0.2   |      |       |       |                                                 |                                                                                                                                                                                                                                                                                           |
| Input Hysteresis                                        |       | 70   |       | +0.2  | Volts                                           |                                                                                                                                                                                                                                                                                           |
| Output Voltage High                                     | 3.5   |      |       |       | mV                                              |                                                                                                                                                                                                                                                                                           |
| Output Voltage Low                                      |       |      |       | 0.4   | Volts                                           |                                                                                                                                                                                                                                                                                           |
| Input Resistance                                        | 12    | 15   |       |       | Volts                                           |                                                                                                                                                                                                                                                                                           |
| Input Current (A, B); V <sub>IN</sub> = 12V             |       |      |       | ±1.0  | kΩ                                              |                                                                                                                                                                                                                                                                                           |
| Input Current (A, B); V <sub>IN</sub> = -7V             |       |      |       | -0.8  | mA                                              |                                                                                                                                                                                                                                                                                           |
| Short-Circuit Current                                   |       |      |       | 85    | mA                                              |                                                                                                                                                                                                                                                                                           |
|                                                         |       |      |       |       | -7V ≤ V <sub>CM</sub> ≤ 12V                     |                                                                                                                                                                                                                                                                                           |
|                                                         |       |      |       |       | V <sub>CM</sub> = 0V                            |                                                                                                                                                                                                                                                                                           |
|                                                         |       |      |       |       | I <sub>O</sub> = -4mA, V <sub>ID</sub> = +200mV |                                                                                                                                                                                                                                                                                           |
|                                                         |       |      |       |       | I <sub>O</sub> = +4mA, V <sub>ID</sub> = -200mV |                                                                                                                                                                                                                                                                                           |
|                                                         |       |      |       |       | -7V ≤ V <sub>CM</sub> ≤ 12V (1 unit load)       |                                                                                                                                                                                                                                                                                           |
|                                                         |       |      |       |       | V <sub>IN</sub> = 12V                           |                                                                                                                                                                                                                                                                                           |
|                                                         |       |      |       |       | V <sub>IN</sub> = -7V                           |                                                                                                                                                                                                                                                                                           |
|                                                         |       |      |       |       | 0V ≤ V <sub>O</sub> ≤ V <sub>CC</sub>           |                                                                                                                                                                                                                                                                                           |
| PARAMETERS                                              |       | MIN. | TYP.  | MAX.  | UNITS                                           | CONDITIONS                                                                                                                                                                                                                                                                                |
| SP1490E/1491E RECEIVER                                  |       |      |       |       |                                                 |                                                                                                                                                                                                                                                                                           |
| AC Characteristics                                      |       |      |       |       |                                                 |                                                                                                                                                                                                                                                                                           |
| Maximum Data Rate                                       | 20    |      |       |       | Mbps                                            | t <sub>PLH</sub> ; R <sub>DIFF</sub> = 54Ω,<br>C <sub>L1</sub> = C <sub>L2</sub> = 100pF; Figures 3 & 8<br>t <sub>PHL</sub> ; R <sub>DIFF</sub> = 54Ω,<br>C <sub>L1</sub> = C <sub>L2</sub> = 100pF; Figures 3 & 8<br>R <sub>DIFF</sub> = 54Ω; C <sub>L1</sub> = C <sub>L2</sub> = 100pF; |
| Receiver Input to Output                                | 20    | 45   | 50    | ns    |                                                 |                                                                                                                                                                                                                                                                                           |
| Receiver Input to Output                                | 20    | 45   | 50    | ns    |                                                 |                                                                                                                                                                                                                                                                                           |
| Diff. Receiver Skew It <sub>PLH</sub> -t <sub>PHL</sub> |       | 5    | 10    | ns    |                                                 |                                                                                                                                                                                                                                                                                           |
| Receiver Tplh/Tphl                                      |       | 40   | 70    | ns    |                                                 |                                                                                                                                                                                                                                                                                           |
|                                                         |       |      |       |       |                                                 |                                                                                                                                                                                                                                                                                           |
| POWER REQUIREMENTS                                      |       |      |       |       |                                                 |                                                                                                                                                                                                                                                                                           |
| Supply Voltage                                          | +4.75 |      | +5.25 | Volts |                                                 |                                                                                                                                                                                                                                                                                           |
| Supply Current                                          |       | 900  |       | μA    |                                                 |                                                                                                                                                                                                                                                                                           |
| ENVIRONMENTAL AND MECHANICAL                            |       |      |       |       |                                                 |                                                                                                                                                                                                                                                                                           |
| Operating Temperature                                   |       |      |       |       |                                                 |                                                                                                                                                                                                                                                                                           |
| Commercial (_C_)                                        | 0     |      | +70   | °C    |                                                 |                                                                                                                                                                                                                                                                                           |
| Industrial (_E_)                                        | -40   |      | +85   | °C    |                                                 |                                                                                                                                                                                                                                                                                           |
| Storage Temperature                                     | -65   |      | +150  | °C    |                                                 |                                                                                                                                                                                                                                                                                           |



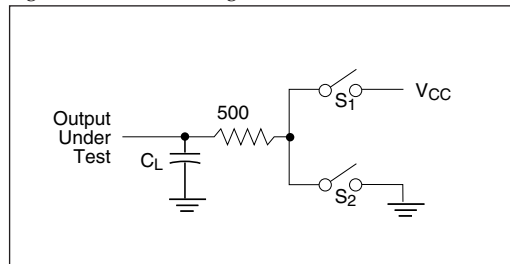
**Figure 1. Driver DC Test Load Circuit**



**Figure 2. Receiver Timing Test Load Circuit**



**Figure 3. Driver/Receiver Timing Test Circuit**



**Figure 4. Driver Timing Test Load #2 Circuit**

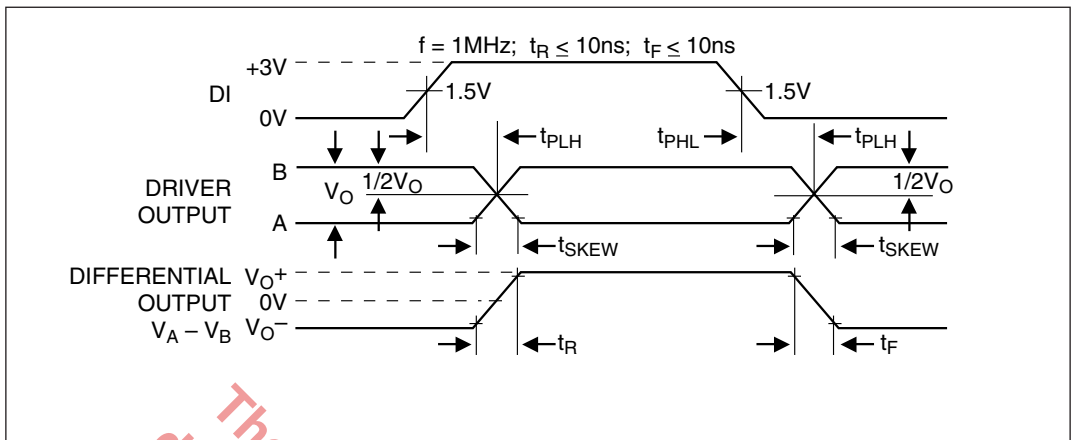


Figure 6. Driver Propagation Delays

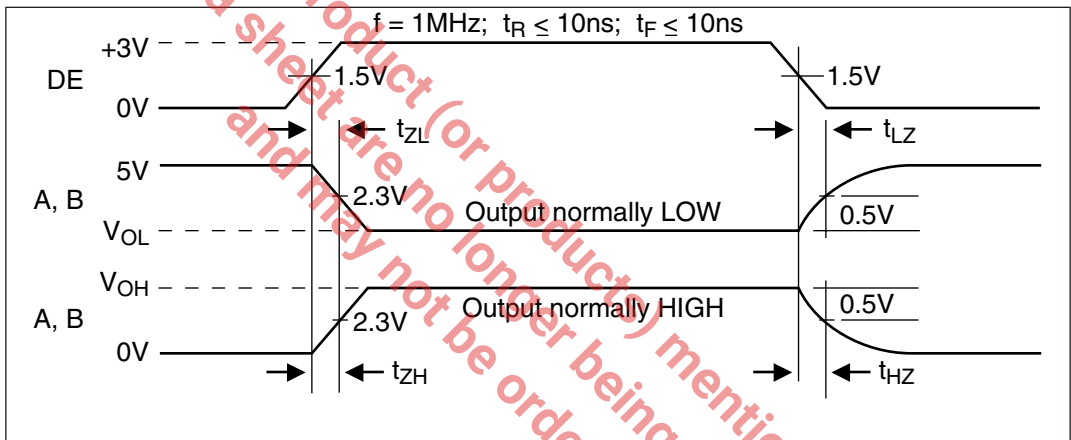


Figure 7. Driver Enable and Disable Times SP1491E only

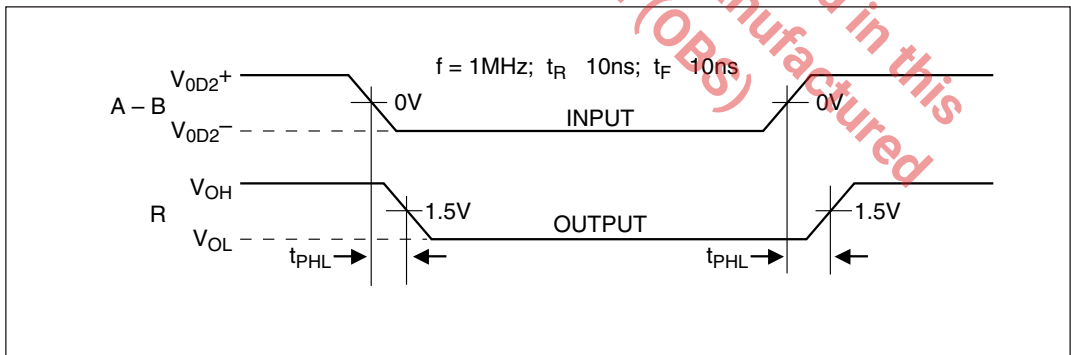


Figure 8. Receiver Propagation Delays

The SP1490E and SP1491E are full-duplex differential transceivers that meet the requirements of RS-485 and RS-422. Fabricated with a Exar 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 SP1490E and SP1491E 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 SP1491E has a driver enable control line which is active high. A logic high on DE (pin 4) of the SP1491E will enable the differential driver outputs.

| INPUTS             |    | OUTPUTS |   |
|--------------------|----|---------|---|
| DE<br>SP1491E only | DI | Y       | Z |
| 1                  | 1  | 1       | 0 |
| 1                  | 0  | 0       | 1 |
| 0                  | x  | z       | z |

Transmit Function Truth Table

A logic low on DE (pin 4) of the SP1491E will tri-state the driver outputs. The SP1490E does not have a driver enable.

#### Receiver...

The receivers for both the SP1490E and SP1491E 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 SP1490E and SP1491E 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 and floating.

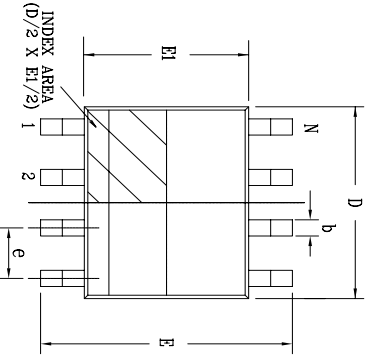
The receiver of the SP1491E has a receiver enable control line which is active low. A logic low on REB (pin 3) of the SP1491E will enable the differential receiver. A logic high on REB (pin 3) of the SP1491E will tri-state the receiver.

| INPUTS             |       | OUTPUTS |
|--------------------|-------|---------|
| RE<br>SP1491E only | A-B   | R       |
| 0                  | +0.2V | 1       |
| 0                  | -0.2V | 0       |
| 0                  | open  | 1       |
| 1                  | x     | z       |

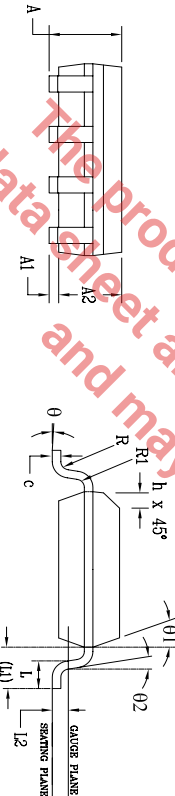
Receive Function Truth Table

| 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    |

| 8 Pin SOICN JEDEC MS-012 Variation AA |          |                                    |      |           |                                        |       |  |  |  |
|---------------------------------------|----------|------------------------------------|------|-----------|----------------------------------------|-------|--|--|--|
| SYMBOLS                               |          | DIMENSIONS IN MM<br>(Control Unit) |      |           | DIMENSIONS IN INCH<br>(Reference Unit) |       |  |  |  |
|                                       | MIN      | NOM                                | MAX  | MIN       | NOM                                    | MAX   |  |  |  |
| A                                     | 1.35     | —                                  | 1.75 | 0.053     | —                                      | 0.069 |  |  |  |
| A1                                    | 0.90     | —                                  | 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                                     | 4.90 BSC |                                    |      | 0.193 BSC |                                        |       |  |  |  |
| N                                     | 8        |                                    |      | 8         |                                        |       |  |  |  |



Top View

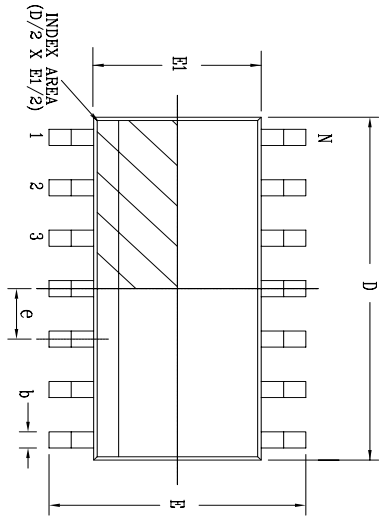


Side View

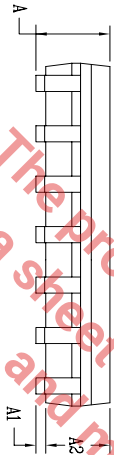
Front View

|                                                                                     |                |                         |               |
|-------------------------------------------------------------------------------------|----------------|-------------------------|---------------|
|  |                | <b>EXAR CORPORATION</b> |               |
| Packaging Approval:                                                                 |                | Drawing No:             |               |
| 8 Pin SOICN PACKAGE OUTLINE                                                         |                | 8-PIN SOICN             |               |
| By: JL                                                                              | Date: 11/16/07 | Revision: C             | Sheet: 1 Of 1 |

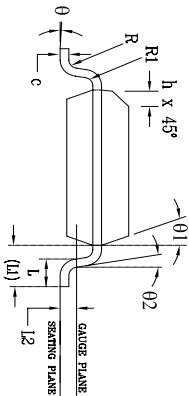
| REVISION HISTORY |                                      |          |       |
|------------------|--------------------------------------|----------|-------|
| REV.             | DESCRIPTION                          | DATE     | APP'D |
| A                | DRAWING ORIGINATOR                   | 04/17/06 | 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<br>(Control Unit) |              |      | DIMENSIONS IN INCH<br>(Reference Unit) |     |       |
|              | MIN                                | NOM          | MAX  | MIN                                    | NOM | MAX   |
| A            | 1.36                               | —            | 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 |
| e            | 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                                  | —   | —     |
| 0            | 0°                                 | —            | 8°   | 0°                                     | —   | 8°    |
| 01           | 5°                                 | —            | 15°  | 5°                                     | —   | 15°   |
| 02           | 0°                                 | —            | —    | 0°                                     | —   | —     |
| D            | 8.65 BSC                           |              |      | 0.341 BSC                              |     |       |
| N            | 14                                 |              |      | 14                                     |     |       |

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

## ORDERING INFORMATION

| Part Number         | TopMark            | Temperature Range    | Package      |
|---------------------|--------------------|----------------------|--------------|
| SP1490ECN-L.....    | 1490ECNYYWW.....   | 0°C to +70°C .....   | 8-Pin NSOIC  |
| SP1490ECN-L/TR..... | 1490ECNYYWW.....   | 0°C to +70°C .....   | 8-Pin NSOIC  |
| SP1490EEN-L.....    | SP1490EENYYWW..... | -40°C to +85°C ..... | 8-Pin NSOIC  |
| SP1490EEN-L/TR..... | SP1490EENYYWW..... | -40°C to +85°C ..... | 8-Pin NSOIC  |
| SP1491ECN-L.....    | SP1491ECNYYWW..... | 0°C to +70°C .....   | 14-Pin NSOIC |
| SP1491ECN-L/TR..... | SP1491ECNYYWW..... | 0°C to +70°C .....   | 14-Pin NSOIC |
| SP1491EEN-L.....    | SP1491EENYYWW..... | -40°C to +85°C ..... | 14-Pin NSOIC |
| SP1491EEN-L/TR..... | SP1491EENYYWW..... | -40°C to +85°C ..... | 14-Pin NSOIC |

/TR = Tape and Reel

Pack quantity is 2500 for Narrow SOIC.

| DATE     | REVISION | DESCRIPTION                                                                      |
|----------|----------|----------------------------------------------------------------------------------|
| 03/08/07 | J        | Legacy Sipex Datasheet                                                           |
| 06/12/09 | 1.0.0    | Convert to Exar format, update ordering information and change revision to 1.0.0 |
| 05/24/13 | 1.0.1    | Correct type error per PCN 13-0503-01 ECN: 1322-02 05/24/13                      |

### Notice

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