

Description

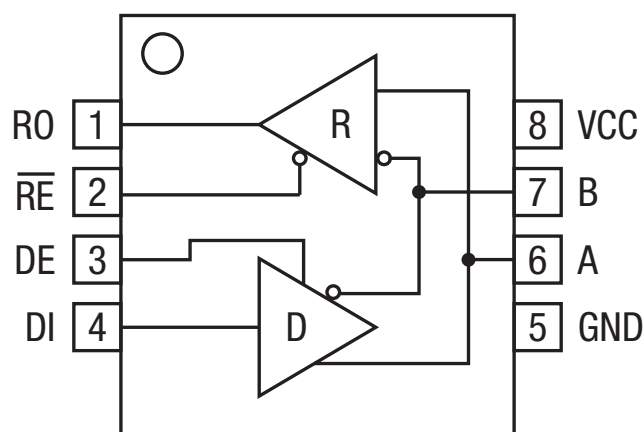
The [SP3494](#) device is a 3.3V low power half-duplex transceiver that meets the specifications of the RS-485 and RS-422 serial protocols. This device is pin-to-pin compatible with the MaxLinear SP3481 device as well as other popular industry standards. The SP3494 features the MaxLinear BiCMOS process, allowing low power operation without sacrificing performance. The partially slew-rate limited drivers minimize EMI and reduce reflections caused by improperly terminated cables allowing error-free data transmission. The SP3494 is a half-duplex partially slew-rate limited transceiver that will deliver a data transmission rate up to 2.5Mbps. The SP3494 is equipped with a low-power shutdown mode and driver/receiver high-Z enable lines.

FEATURES

- Operates from a single 3.3V supply
- Interoperable with 5.0V logic
- $\pm 200\text{mV}$ receiver input sensitivity
- -7V to +12V common-mode input voltage range
- Allows up to 32 transceivers on the serial bus
- Driver/receiver enable lines
- $10\mu\text{A}$ low-power shutdown mode
- Compatibility with the MAX3486 and 75176 industry standard pinout

Ordering Information - [Back Page](#)

Block Diagram



SP3494

Absolute Maximum Ratings

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

V_{CC} 6.0V

Input Voltages

Drivers -0.3V to 6.0V

Receivers..... ±14V

Output Voltages

Drivers +/-14V

Receivers..... -0.3V to 6.0V

Storage Temperature -65°C to +150°C

Maximum Junction Temperature, T_J 125°C

Power Dissipation

8-pin NSOIC 600mW

(derate 6.90mW/°C above +70°C)

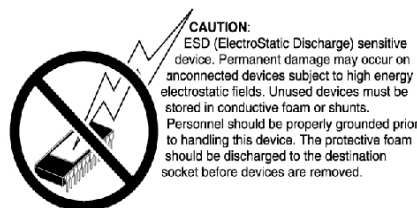
Operating Conditions

Package Power Dissipation

8-pin NSOIC Θ_{JA} 128.4°C/W

ESD Rating

Human Body Model (HBM)..... ±2kV



Electrical Characteristics

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

| PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|--|------|------|----------|-------|--|
| SP3494 Driver DC Characteristics | | | | | |
| 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, DI, RE |
| Input low voltage | | | 0.8 | V | Applies to DE, DI, RE |
| Input current | | | ±10 | μA | Applies to DE, DI, RE |
| Driver short circuit current $V_{out} = HIGH$ | | | ±250 | mA | $-7V \leq V_O \leq +12V$; Figure 8 |
| Driver short circuit current $V_{out} = LOW$ | | | ±250 | mA | $-7V \leq V_O \leq +12V$; Figure 8 |
| SP3494 Driver AC Characteristics | | | | | |
| Maximum data rate | 2.5 | | | Mbps | $\overline{RE} = V_{CC}$, $DE = V_{CC}$ |
| Driver input to output, t_{plh} | 20 | 45 | 75 | ns | Figures 2 & 9 |
| Driver input to output, t_{phl} | 20 | 45 | 75 | ns | Figures 2 & 9 |
| Differential driver skew | | 10 | | ns | $ t_{D01} - t_{D02} $, Figures 2 and 10 |
| Driver rise or fall time | | 30 | 70 | ns | From 10%-90%; Figures 3 and 10 |

Electrical Characteristics (Continued)

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

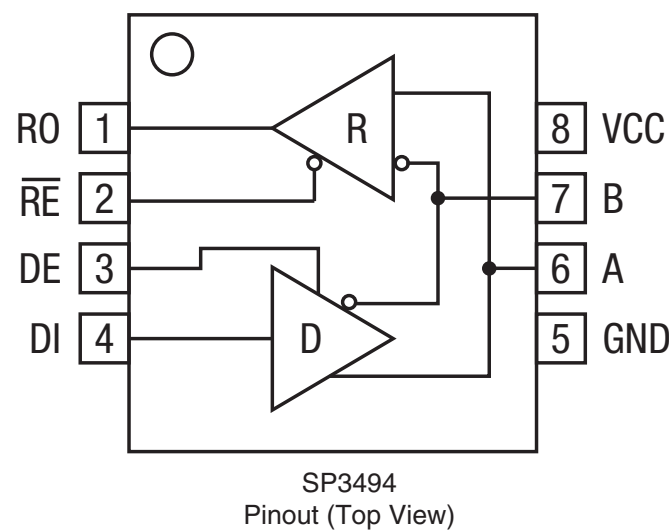
| PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|---|--------------|------|---------|------------|--|
| SP3494 Driver AC Characteristics (Continued) | | | | | |
| Driver enable to output high | | 52 | 120 | ns | Figures 4 and 11 |
| Driver enable to output low | | 60 | 120 | ns | Figures 5 and 11 |
| Driver disable time from low | | 40 | 120 | ns | Figures 5 and 11 |
| Driver disable time from high | | 60 | 120 | ns | Figures 4 and 11 |
| SP3494 Receiver DC Characteristics | | | | | |
| Differential input threshold | -0.2 | | 0.2 | Volts | $-7V \leq V_{CM} \leq 12V$ |
| Input hysteresis | | 20 | | mV | $V_{CM} = 0V$ |
| Output voltage HIGH | $V_{CC}-0.4$ | | | Volts | $V_{ID} = +200mV, -1.5mA$ |
| Output voltage LOW | | | 0.4 | Volts | $V_{ID} = -200mV, 2.5mA$ |
| Three-state (high impedance) output current | | | ± 1 | μA | $0V \leq V_O \leq V_{CC}; \overline{RE} = V_{CC}$ |
| Input resistance | 12 | 15 | | k Ω | $-7V \leq V_{CM} \leq 12V$ |
| Input current (A, B); $V_{IN} = 12V$ | | | 1.0 | mA | $DE = 0V, V_{CC} = 0V$ or $3.6V, V_{IN} = 12V$ |
| Input current (A, B); $V_{IN} = -7V$ | | | -0.8 | mA | $DE = 0V, V_{CC} = 0V$ or $3.6V, V_{IN} = -7V$ |
| Short circuit current | 7 | | 60 | mA | $0V \leq V_{CM} \leq V_{CC}$ |
| SP3494 Receiver AC Characteristics | | | | | |
| Maximum data rate | 2.5 | | | Mbps | $\overline{RE} = 0V, DE = 0V$ |
| Receiver input to output, t_{PLH} | 40 | 70 | 100 | ns | Figures 6 and 12 |
| Receiver input to output, t_{PHL} | 40 | 70 | 100 | ns | Figures 6 and 12 |
| Differential receiver skew | | 10 | | ns | $t_{RSKEW} = t_{RPHL} - t_{RPLH} $, Figures 6 and 12 |
| Receiver enable to output low | | 35 | 60 | ns | Figures 7 and 13, S_1 closed, S_2 open |
| Receiver enable to output high | | 35 | 60 | ns | Figures 7 and 13, S_2 closed, S_1 open |
| Receiver disable from low | | 35 | 60 | ns | Figures 7 and 13, S_1 closed, S_2 open |
| Receiver disable from high | | 35 | 60 | ns | Figures 7 and 13, S_2 closed, S_1 open |

Electrical Characteristics, Continued

T_{AMB} = T_{MIN} to T_{MAX} and V_{CC} = 3.3V ±5% unless otherwise noted.

| PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|--|------|------|------|-------|--|
| SP3494 Shutdown Timing | | | | | |
| Time to shutdown | 50 | 75 | 200 | ns | $\overline{RE} = 3.3V, DE = 0V$ |
| Driver enable from shutdown to output high | | 65 | 150 | ns | Figures 4 and 11 |
| Driver enable from shutdown to output low | | 65 | 150 | ns | Figures 5 and 11 |
| Receivers enabled from shutdown to output high | | 50 | 200 | ns | Figures 7 and 13, S ₂ closed, S ₁ open |
| Receivers enabled from shutdown to output low | | 50 | 200 | ns | Figures 7 and 13, S ₁ closed, S ₂ open |
| Power Requirements | | | | | |
| Supply current, no load | | 1000 | 2000 | μA | $\overline{RE}, DI = 0V$ or V_{CC} ; $DE = V_{CC}$ |
| Supply current, no load | | 800 | 1500 | μA | $\overline{RE} = 0V, DI = 0V$ or $V_{CC}, DE = 0V$ |
| Shutdown mode | | | 10 | μA | $DE = 0V, \overline{RE} = V_{CC}$ |

Pin Functions



| Pin Number | Pin Name | Description |
|------------|-----------------|--|
| 1 | RO | Receiver output |
| 2 | \overline{RE} | Receiver Output Enable Active LOW |
| 3 | DE | Driver Output Enable Active HIGH |
| 4 | DI | Driver Input |
| 5 | GND | Ground Connection |
| 6 | A | Non-Inverting Driver Output / Receiver Input |
| 7 | B | Inverting Driver Output / Receiver Input |
| 8 | VCC | Positive Supply 3.3V ±5% |

Test Circuits

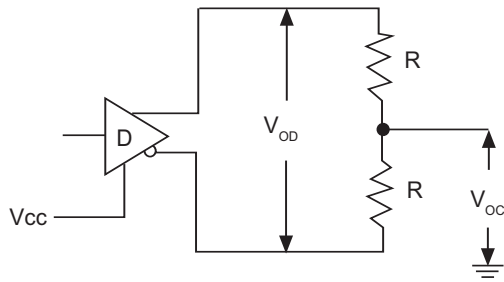


Figure 1. Driver DC Test Load Circuit

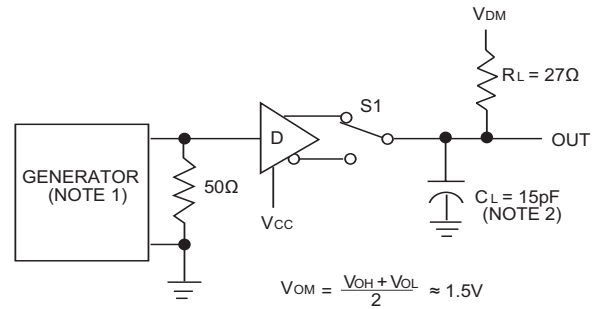


Figure 2. Driver Propagation Delay Test Circuit

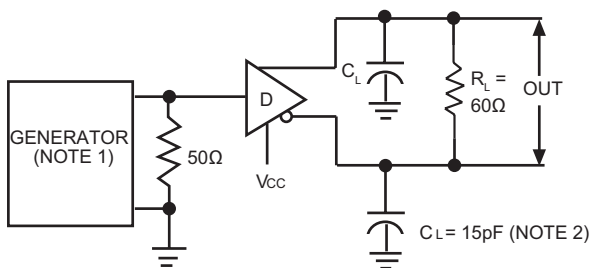


Figure 3. Driver Differential Output Delay and Transition Time Circuit.

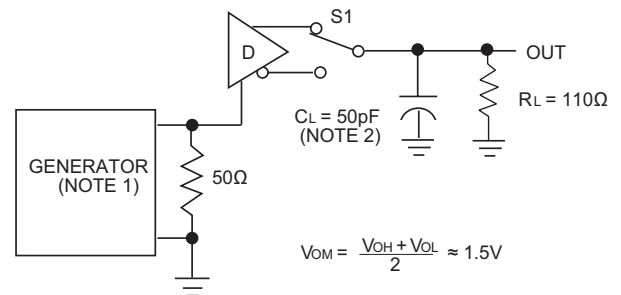


Figure 4. Driver Enable and Disable Timing Circuit, Output High

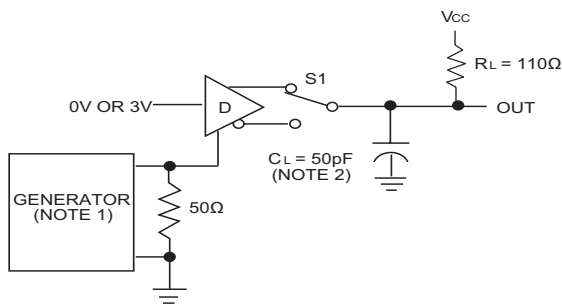


Figure 5. Driver Enable and Disable Timing Circuit, Output Low

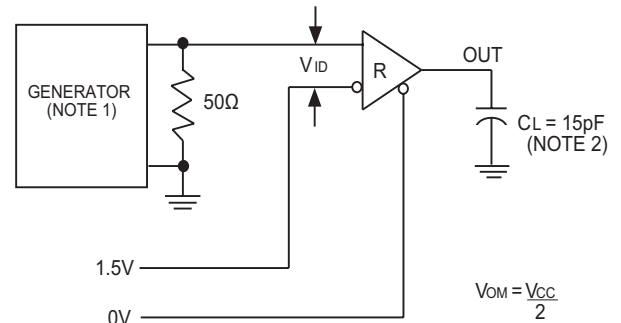


Figure 6. Receiver Propagation Delay Test Circuit

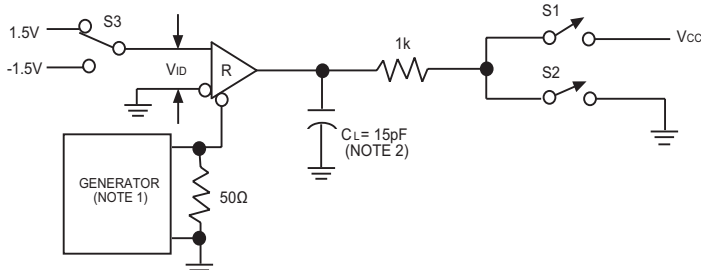


Figure 7. Receiver Enable and Disable Timing Circuit

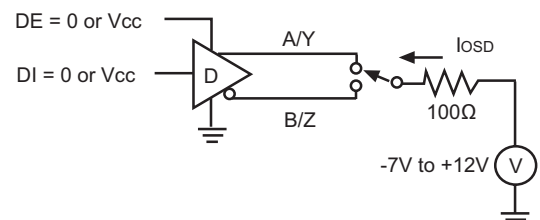


Figure 8. Driver Short Circuit Current Limit Test

NOTES

- 1: The input pulse is supplied by a generator with the following characteristics:
PRR = 250kHz, 50% duty cycle, $t_r < 6.0\text{ns}$, $Z_O = 50\Omega$.
- 2: C_L includes probe and stray capacitance.

Switching Waveforms

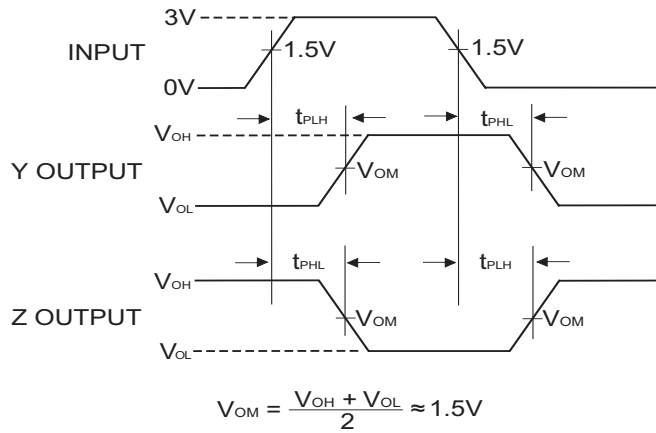


Figure 9. Driver Propagation Delay Waveforms

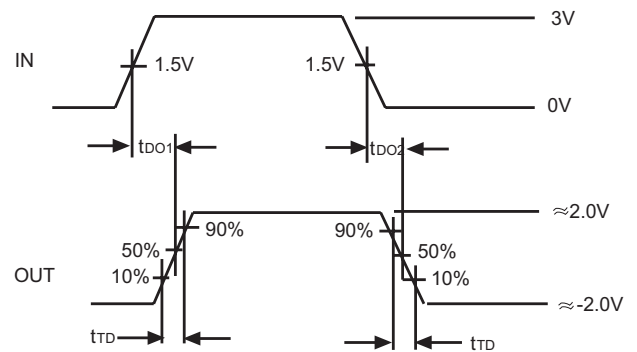


Figure 10. Driver Differential Output Delay and Transition Time Waveforms

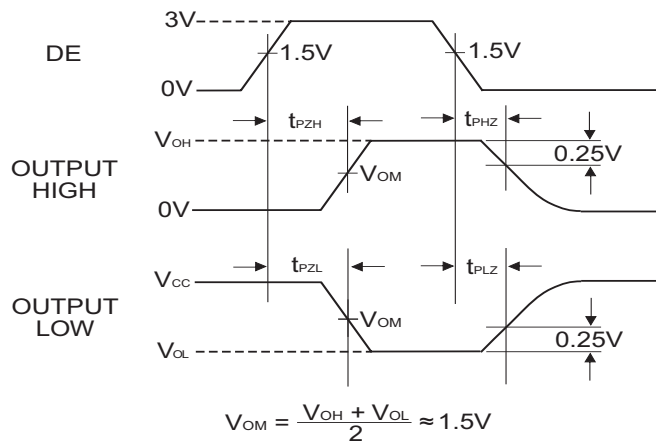


Figure 11. Driver Enable and Disable Timing Waveforms

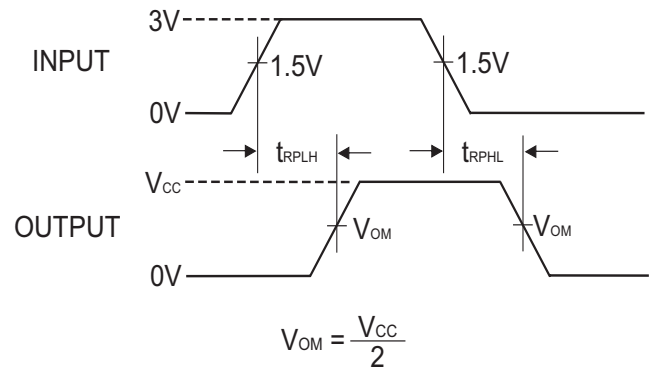


Figure 12. Receiver Propagation Delay Waveforms

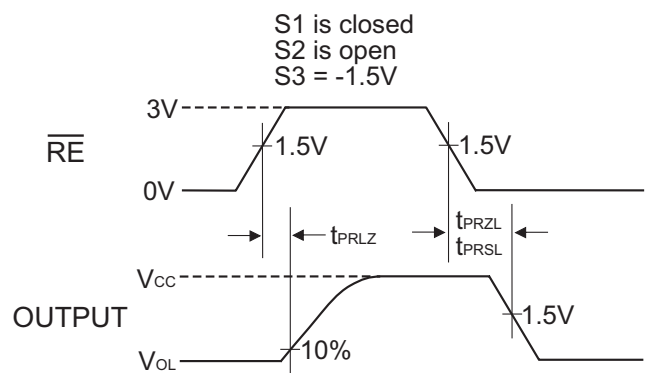
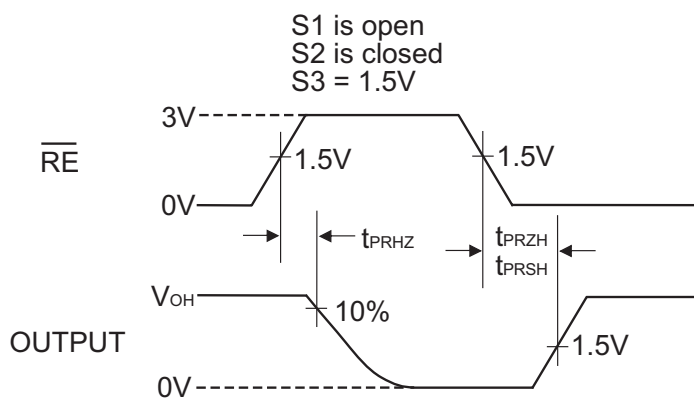


Figure 13. Receiver Enable and Disable Waveforms

Description

The SP3494 is a 3.3V low power half-duplex transceiver that meets the electrical specifications of the RS-485 and RS-422 serial protocols. This device is pin-to-pin compatible with the MaxLinear SP3481 and SP481 devices as well as popular industry standards such as the MAX3486 and the 75176. The SP3494 feature Maxlinear's BiCMOS process allowing low power operation without sacrificing performance. The SP3494 has a partially slew rate limited driver with a data transmission rate of 2.5Mbps.

Driver

The driver outputs of the SP3494 are differential outputs. The typical voltage output swing with no load will be 0 volts to V_{CC} . With worst case loading of 54Ω across the differential outputs, the driver can maintain greater than 1.5V voltage levels.

The SP3494 driver has an enable control line which is active HIGH. A logic HIGH on DE (pin 3) will enable the differential driver outputs. A logic LOW on the DE (pin 3) will force the driver outputs to high impedance (high-Z).

The SP3494 driver will operate up to 2.5Mbps. In addition to adhering to the 250mA I_{SC} maximum limit on the driver output, the driver output short-circuit protection will allow the device to withstand an infinite short circuit over the -7.0V to 12V common mode range without damage.

Receiver

The receiver has differential inputs with an input sensitivity of $\pm 200\text{mV}$. Input impedance of the receiver 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 receiver is equipped with a fail-safe feature which guarantees that the receiver output will be in a high state when the input is left unconnected. The receiver of the SP3494 operate up to 2.5Mbps.

The receiver of the SP3494 has an enable control line which is active LOW. A logic LOW on $\overline{\text{RE}}$ (pin 2) of the SP3494 will enable the differential receiver. A logic HIGH on $\overline{\text{RE}}$ (pin 2) will disable the receiver.

The SP3494 is equipped with a shutdown mode. To enable the shutdown state, both the driver and receiver must be disabled simultaneously. A logic LOW on DE (pin 3) and a logic HIGH on $\overline{\text{RE}}$ (pin 2) will put the SP3494 into shutdown. In shutdown, the supply current will drop to less than $10\mu\text{A}$.

| INPUTS | | | OUTPUTS | |
|------------------------|----|----|----------------|---|
| $\overline{\text{RE}}$ | DE | DI | LINE CONDITION | A |
| X | 1 | 1 | No Fault | 1 |
| X | 1 | 0 | No Fault | 0 |
| X | 0 | X | X | Z |

Table 1. Transmit Function Truth Table

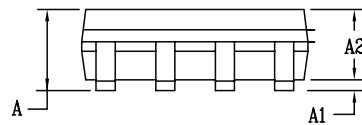
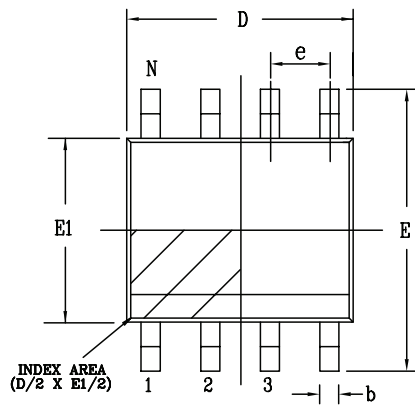
| INPUTS | | OUTPUTS | |
|------------------------|----|-------------|---|
| $\overline{\text{RE}}$ | DE | A - B | R |
| 0 | 0 | 0.2V | 1 |
| 0 | 0 | -0.2V | 0 |
| 0 | 0 | Inputs Open | 1 |
| 1 | 0 | X | Z |

Table 2. Receive Function Truth Table

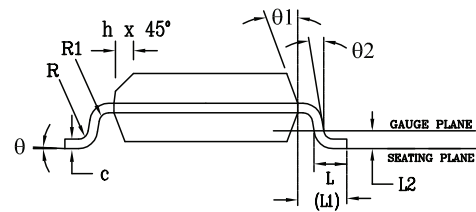
Mechanical Dimensions

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

Ordering Information⁽¹⁾

| Part Number | Operating Temperature Range | Lead-Free | Package | Packaging Method |
|---------------|-----------------------------|--------------------|-------------|------------------|
| SP3494CN-L/TR | 0°C to 70°C | Yes ⁽²⁾ | 8-pin NSOIC | Reel |
| SP3494EN-L | -40°C to 85°C | | | Tube |
| SP3494EN-L/TR | | | | Reel |

NOTE:

1. Refer to www.exar.com/SP3494 for most up-to-date Ordering Information.
2. Visit www.exar.com for additional information on Environmental Rating.

Revision History

| Revision | Date | Description |
|----------|-------|--|
| 10/15/02 | -- | Legacy Sipex Datasheet |
| 07/10/12 | 1.0.0 | Convert to Exar Format. Update ordering information and add new Figure 8 - Driver Short Circuit Current Limit Test Circuit. Remove EOL device SP3493. |
| 09/07/17 | 1.0.1 | Update to MaxLinear logo. Remove GND from Differential Output Voltage min (page 2), correct part number (SP3485 Receiver, page 3). Added maximum junction temperature, package power dissipation and ESD rating. Update format and ordering information table. |

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