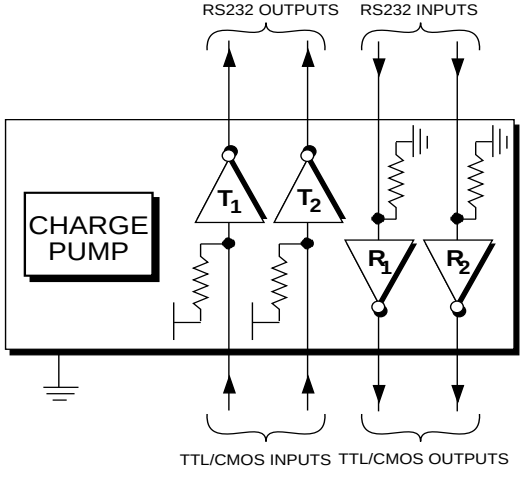
# +3V to +5V RS-232 Line Driver/Receiver

- Operates from 3.3V or 5V Power Supply
- Meets All EIA-232D and V.28 Specifications at 5V
- Meets EIA-562 Specifications at 3.3V
- Two Drivers and Receivers
- Operates with 0.1µF to 10µF Capacitors
- High Data Rate — 120kbps Under Load
- Low Power Shutdown ≤1µA
- 3-State TTL/CMOS Receiver Outputs
- Low Power CMOS — 5mA Operation


## DESCRIPTION…

The **Sipex SP385A** is an enhanced version of the **Sipex** SP200 family of RS232 line drivers/receivers. The **SP385A** offers +3.3V operation for EIA-562 and EIA-232 applications. The **SP385A** maintains the same performance features offered in its predecessors. The **SP385A** is available in plastic SOIC or SSOP packages operating over the commercial and industrial temperature ranges. The **SP385A** is pin compatible to the LTC1385 EIA-562 transceiver, except the drivers in the **SP385A** can only be disabled with the ON/$\overline{\text{OFF}}$ pin.



## ABSOLUTE MAXIMUM RATINGS

This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

$V_{CC}$ ..... +6V
$V^+$ ..... (Vcc-0.3V) to +13.2V
$V^-$ ..... 13.2V
Input Voltages
$T_{IN}$ ..... -0.3 to (Vcc +0.3V)
$R_{IN}$ ..... ±15V
Output Voltages
$T_{OUT}$ ..... (V+, +0.3V) to (V-, -0.3V)
$R_{OUT}$ ..... -0.3V to (Vcc +0.3V)
Short Circuit Duration
$T_{OUT}$ ..... Continuous
Power Dissipation
CERDIP ..... 675mW
(derate 9.5mW/°C above +70°C)
Plastic DIP ..... 375mW
(derate 7mW/°C above +70°C)
Small Outline ..... 375mW
(derate 7mW/°C above +70°C)

## SPECIFICATIONS

$V_{CC}$=+3.3V±10%; 0.1µF charge pump capacitors; $T_{MIN}$ to $T_{MAX}$ unless otherwise noted.

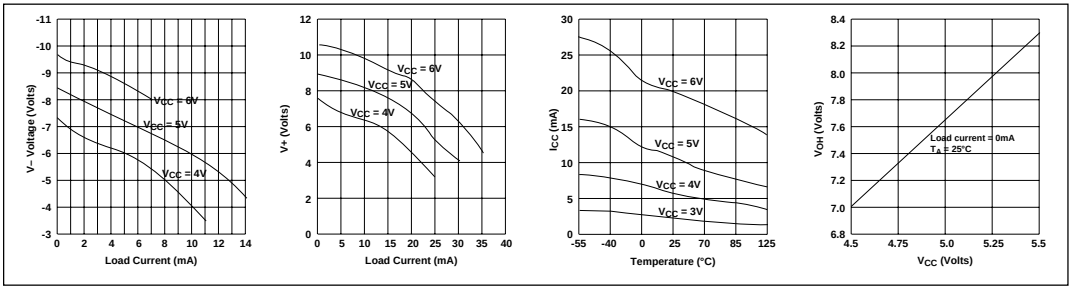
| PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|---|---|---|---|---|---|
| **TTL INPUT** | | | | | |
| Logic Threshold | | | | | |
| Low | | | 0.8 | Volts | $T_{IN}$ ; ON/$\overline{OFF}$ Vcc = 3.3V |
| High | 2.0 | | | Volts | $T_{IN}$ ; ON/$\overline{OFF}$ Vcc = 3.3V |
| Logic Pullup Current | | 15 | 200 | µA | $T_{IN}$ = 0V |
| Maximum Data Rate | 120 | | | kbps | $C_L$ = 2500pF, $R_L$ = 3kΩ |
| **TTL OUTPUT** | | | | | |
| TTL/CMOS Output | | | | | |
| Voltage, Low | | | 0.5 | Volts | $I_{OUT}$ = 3.2mA; Vcc = 3.3V |
| Voltage, High | 2.4 | | | Volts | $I_{OUT}$ = -1.0mA |
| Leakage Current; $T_A$ = +25°C | | 0.05 | ±10 | µA | $\overline{ON/OFF}$=0V, 0V ≤ $V_{OUT}$ ≤ $V_{CC}$ |
| **EIA-562 OUTPUT** | | | | | |
| Output Voltage Swing | ±3.7 | ±4.2 | | Volts | All transmitter outputs loaded with 3kΩ to ground |
| Power-Off Output Resistance | 300 | | | Ω | $V_{CC}$ = 0V; $V_{OUT}$ = ±2V |
| Output Short Circuit Current | | ±10 | | mA | Infinite duration |
| **EIA-562 INPUT** | | | | | |
| Voltage Range | -15 | | +15 | Volts | |
| Voltage Threshold | | | | | |
| Low | 0.8 | 1.2 | | Volts | $V_{CC}$ = 3.3V, $T_A$ = +25°C |
| High | | 1.7 | 2.4 | Volts | $V_{CC}$ = 3.3V, $T_A$ = +25°C |
| Hysteresis | 0.2 | 0.5 | 1.0 | Volts | $V_{CC}$ = 3.3V, $T_A$ = +25°C |
| Resistance | 3 | 5 | 7 | kΩ | $V_{IN}$ = 15V to –15V |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Driver Propagation Delay | | 4.0 | | µs | TTL to RS-562 |
| Receiver Propagation Delay | | 1.5 | | µs | RS-562 to TTL |
| Instantaneous Slew Rate | | | 30 | V/µs | $C_L$ = 10pF, $R_L$ = 3kΩ - 7kΩ; $T_A$ = +25°C |
| Transition Region Slew Rate | | 10 | | V/µs | $C_L$ = 2500pF, $R_L$ = 3kΩ; measured from +2V to -2V or -2V to +2V |
| Output Enable Time | | 300 | | ns | |
| Output Disable Time | | 1000 | | ns | |
| **POWER REQUIREMENTS** | | | | | |
| $V_{CC}$ Power Supply Current | | 3 | 6 | mA | No load, $T_A$ = +25°C; $V_{CC}$ = 3.3V |
| | | 8 | | mA | All transmitters $R_L$ = 3kΩ |
| | | | | | $T_A$ = +25°C |
| Shutdown Supply Current | | 0.010 | 5 | µA | $V_{CC}$ = 3.3V, $T_A$ = +25°C |

## SPECIFICATIONS

$V_{CC}$=+5V±10%; 0.1µF charge pump capacitors; $T_{MIN}$ to $T_{MAX}$ unless otherwise noted.

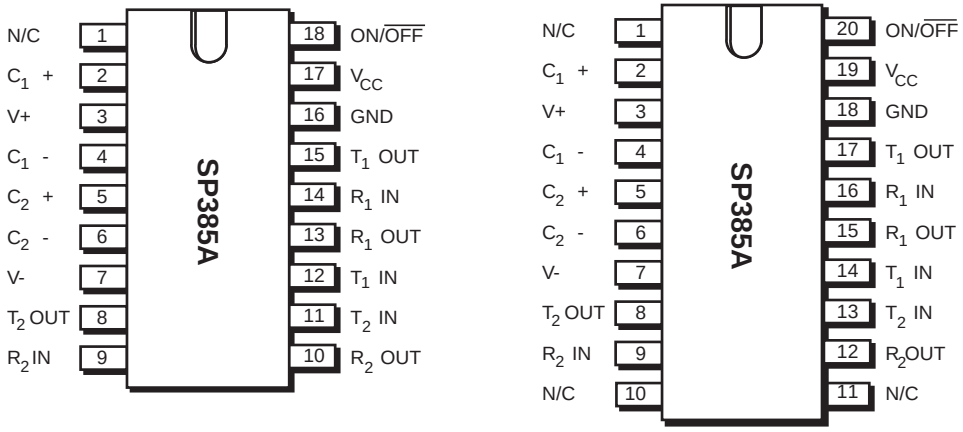
| PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|---|---|---|---|---|---|
| **TTL INPUT** | | | | | |
| Logic Threshold | | | | | |
| Low | | | 0.8 | Volts | $T_{IN}$ ; ON/$\overline{OFF}$ |
| High | 2.0 | | | Volts | $T_{IN}$ ; ON/$\overline{OFF}$ |
| Logic Pullup Current | | 15 | 200 | µA | $T_{IN}$ = 0V |
| Maximum Data Rate | 120 | | | kbps | $C_L$ = 2500pF, $R_L$= 3kΩ |
| **TTL OUTPUT** | | | | | |
| TTL/CMOS Output | | | | | |
| Voltage, Low | | | 0.4 | Volts | $I_{OUT}$ = 3.2mA; Vcc = +5V |
| Voltage, High | 3.5 | | | Volts | $I_{OUT}$ = -1.0mA |
| Leakage Current; $T_A$ = +25°C | | 0.05 | ±10 | µA | ON/$\overline{OFF}$ = Ø, 0V ≤ $V_{OUT}$ ≤ $V_{CC}$ |
| **EIA-232 OUTPUT** | | | | | |
| Output Voltage Swing | ±5 | ±9 | | Volts | All transmitter outputs loaded with 3kΩ to ground |
| Power-Off Output Resistance | 300 | | | Ω | $V_{CC}$ = 0V; $V_{OUT}$ = ±2V |
| Output Short Circuit Current | | ±18 | | mA | Infinite duration |
| **EIA-232 INPUT** | | | | | |
| Voltage Range | -15 | | +15 | Volts | |
| Voltage Threshold | | | | | |
| Low | 0.8 | 1.2 | | Volts | $V_{CC}$ = 5V, $T_A$ = +25°C |
| High | | 1.7 | 2.4 | Volts | $V_{CC}$ = 5V, $T_A$ = +25°C |
| Hysteresis | 0.2 | 0.5 | 1.0 | Volts | $V_{CC}$ = 5V, $T_A$ = +25°C |
| Resistance | 3 | 5 | 7 | kΩ | $V_{IN}$ = 15V to –15V |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Driver Propagation Delay | | 4.0 | | µs | TTL to RS-232 |
| Receiver Propagation Delay | | 1.5 | | µs | RS-232 to TTL |
| Instantaneous Slew Rate | | | 30 | V/µs | $C_L$ = 10pF, $R_L$= 3kΩ - 7kΩ; $T_A$ =+25°C |
| Transition Region Slew Rate | | 10 | | V/µs | $C_L$ = 2500pF, $R_L$= 3kΩ; measured from +3V to -3V or -3V to +3V |
| Output Enable Time | | 400 | | ns | |
| Output Disable Time | | 250 | | ns | |
| **POWER REQUIREMENTS** | | | | | |
| $V_{CC}$ Power Supply Current | | 10 | 15 | mA | No load, $T_A$= +25°C; $V_{CC}$ = 5V |
| | | 25 | | mA | All transmitters $R_L$ = 3kΩ; $T_A$ = +25°C |
| Shutdown Supply Current | | 1 | 10 | µA | $V_{CC}$ = 5V, $T_A$ = +25°C |

## PERFORMANCE CURVES

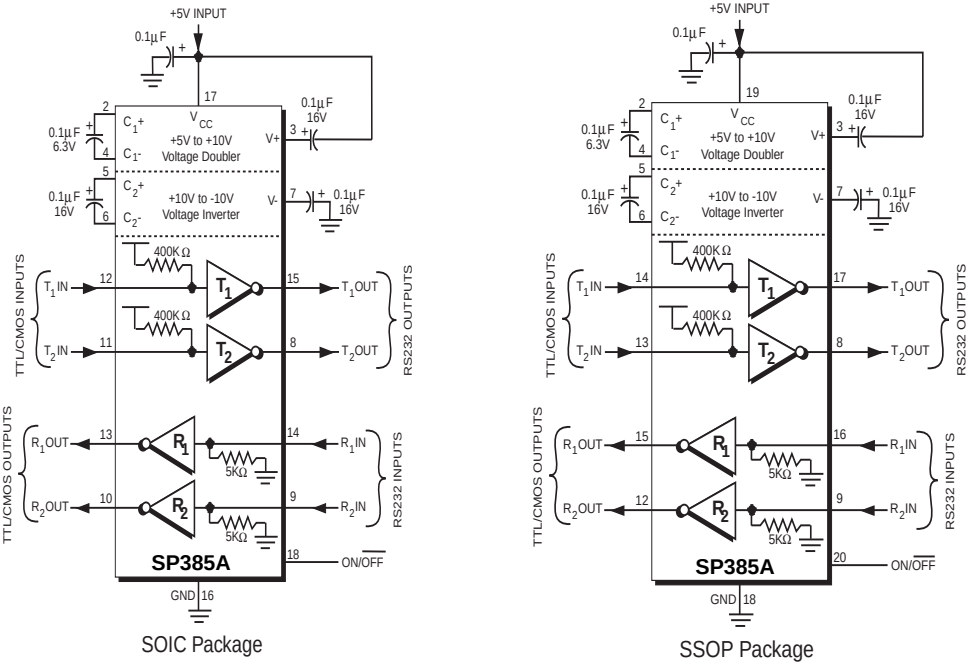


## PINOUT…




## TYPICAL OPERATING CIRCUIT…



## FEATURES…

The **Sipex SP385A** is a +3V to +5V EIA-232/EIA-562 line transceiver. It is a pin-for-pin alternative for the SP310A and will operate in the same socket with capacitors ranging from 0.1µF to 10µF, either polarized or non–polarized, in +3V supplies. The **SP385A** offers the same features such as 120kbps guaranteed transmission rate, increased drive current for longer and more flexible cable configurations, low power dissipation and overall ruggedized construction for commercial and industrial environments. The **SP385A** also includes a shutdown feature that tri-states the drivers and the receivers.

The **SP385A** includes a charge pump voltage converter which allows it to operate from a single +3.3V or +5V supply. These converters double the $V_{CC}$ voltage input in order to generate the EIA-232 or EIA-562 output levels. For +5V operation, the **SP385A** driver outputs adhere to all EIA-232D and CCITT V.28 specifications. While at +3.3V operation, the outputs adhere to EIA-562 specifications. Due to **Sipex's** efficient charge pump design, the charge pump levels and the driver outputs are less noisy than other 3V EIA-232 transceivers.

The **SP385A** has a single control line which simultaneously shuts down the internal DC/DC converter and puts all transmitter and receiver outputs into a high impedance state.

The **SP385A** is available in 18-pin plastic SOIC and 20-pin plastic SSOP packages for operation over commercial and industrial temperature ranges. Please consult the factory for surface-mount packaged parts supplied on tape-on-reel as well as parts screened to MIL-M-38510.

The **SP385A** is ideal for +3.3V battery applications requiring low power operation. The charge pump strength allows the drivers to provide ±4.0V signals, plenty for typical EIA-232 applications since the EIA-232 receivers have input sensitivity levels of less than ±3V.

## THEORY OF OPERATION

The **SP385A** device is made up of three basic circuit blocks — 1) a driver/transmitter, 2) a receiver and 3) a charge pump.

### Driver/Transmitter

The drivers are inverting transmitters, which accept TTL or CMOS inputs and output the RS-232 signals with an inverted sense relative to the input logic levels. Typically the RS-232 output voltage swing is ±9V for 5V supply and ±4.2V for 3.3V supply. Even under worst case loading conditions of 3kΩ and 2500pF, the output is guaranteed to be ±5V for a 5V supply and ±3.7V for a 3.3V supply which adheres to EIA-232 and EIA-562 specifications, respecitively. The transmitter outputs are protected against infinite short-circuits to ground without degradation in reliability.

The instantaneous slew rate of the transmitter output is internally limited to a maximum of 30V/µs in order to meet the standards [EIA 232-D 2.1.7, Paragraph (5)]. However, the transition region slew rate of these enhanced products is typically 10V/µs. The smooth transition of the loaded output from $V_{OL}$ to $V_{OH}$ clearly meets the monotonicity requirements of the standard [EIA 232-D 2.1.7, Paragraphs (1) & (2)].

### Receivers

The receivers convert RS-232 input signals to inverted TTL signals. Since the input is usually from a transmission line, where long cable lengths and system interference can degrade the signal, the inputs have a typical hysteresis margin of 500mV. This ensures that the receiver is virtually immune to noisy transmission lines.

The input thresholds are 0.8V minimum and 2.4V maximum, again well within the ±3V RS-232 requirements. The receiver inputs are also protected against voltages up to ±15V. Should an input be left unconnected, a 5kΩ pull-down resistor to ground will commit the output of the receiver to a high state.

In actual system applications, it is quite possible for signals to be applied to the receiver inputs before power is applied to the receiver circuitry. This occurs for example when a PC user attempts to print only to realize the printer wasn't turned on. In this case an RS-232 signal from the PC will appear on the receiver input at the printer. When the printer power is turned on, the receiver will operate normally. All of these enhanced devices are fully protected.

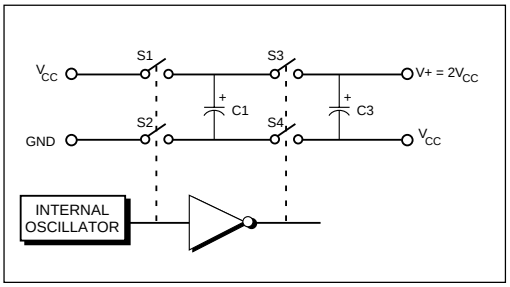



*Figure 1. Charge Pump Voltage Doubler*

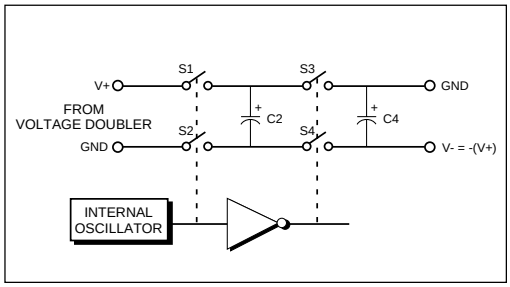



*Figure 2. Charge Pump Voltage Inverter*

## Charge Pump

The charge pump section of the these devices allows the circuit to operate from a single +5V ±10% power supply by generating the required operating voltages internal to the devices. The charge pump consists of two sections — 1) a voltage doubler and 2) a voltage inverter.

As shown in *Figure 1*, an internal oscillator triggers the charge accumulation and voltage inversion. The voltage doubler momentarily stores a charge on capacitor $C_1$ equal to $V_{cc}$, referenced to ground. During the next transition of the oscillator this charge is boot-strapped to transfer charge to capacitor $C_3$. The voltage across $C_3$ is now from $V_{cc}$ to $V^+$.

In the inverter section *(Figure 2)*, the voltage across $C_3$ is transferred to $C_2$ forcing a range of 0V to $V^+$ across $C_2$. Boot-strapping of $C_2$ will then transfer charge to $C_4$ to genrate $V^-$.

One of the significant enhancements over previous products of this type is that the values of the capacitors are no longer critical and have been decreased in size considerably to 0.1µF. Because the charge pump runs at a higher frequency, the 0.1µF capacitors are sufficient to transfer and sustain charges to the two transmitters.

## APPLICATION HINTS

### Protection From Shorts to ±15V

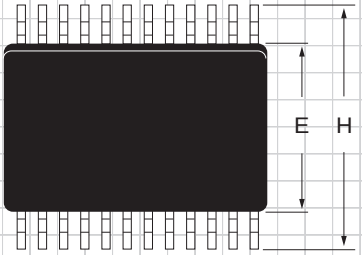
The driver outputs are protected against shorts to ground, other driver outputs, and $V^+$ or $V^-$. If the possibility exists that the outputs could be inadvertently connected to voltages higher than ±15V, then it is recommended that external protection be provided. For protection against voltages exceeding ±15V, two back-to-back zener diodes connected from each output to ground will clamp the outputs to an acceptable voltage level.

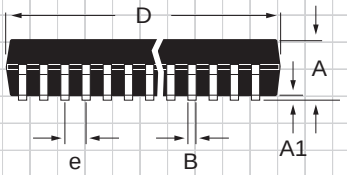
### Shutdown (ON/$\overline{\text{OFF}}$)

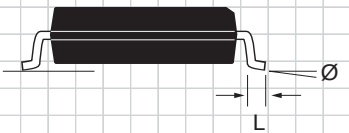
The **SP385A** has a shut-down/standby mode to conserve power in battery-powered systems. To activate the shutdown mode, which stops the operation of the charge pump, a logic "0" is applied to the appropriate control line. The shutdown mode is controlled on the **SP385A** by a logic "0" on the ON/$\overline{\text{OFF}}$ control line (pin 18 for the SOIC and pin 20 for the SSOP packages); this puts the transmitter outputs in a tri–state mode.

## PACKAGE: PLASTIC SMALL OUTLINE (SOIC) (WIDE)



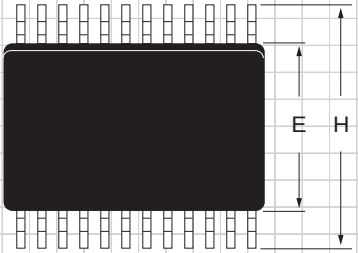



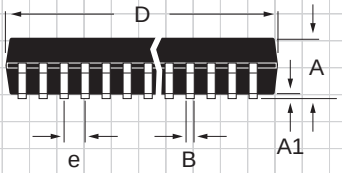



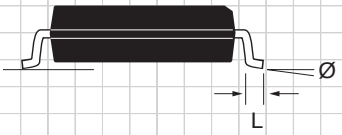

| DIMENSIONS (Inches) Minimum/Maximum (mm) | 18–PIN |
|---|---|
| A | 0.093/0.104 (2.352/2.649) |
| A1 | 0.004/0.012 (0.102/0.300) |
| B | 0.013/0.020 (0.330/0.508) |
| D | 0.447/0.463 (11.35/11.74) |
| E | 0.291/0.299 (7.402/7.600) |
| e | 0.050 BSC (1.270 BSC) |
| H | 0.394/0.419 (10.00/10.64) |
| L | 0.016/0.050 (0.406/1.270) |
| Ø | 0°/8° (0°/8°) |

## PACKAGE: PLASTIC SHRINK SMALL OUTLINE (SSOP)




| DIMENSIONS (Inches) Minimum/Maximum (mm) | 20–PIN |
|---|---|
| A | 0.068/0.078 (1.73/1.99) |
| A1 | 0.002/0.008 (0.05/0.21) |
| B | 0.010/0.015 (0.25/0.38) |
| D | 0.278/0.289 (7.07/7.33) |
| E | 0.205/0.212 (5.20/5.38) |
| e | 0.026 BSC (0.065 BSC) |
| H | 0.301/0.311 (7.65/7.90) |
| L | 0.022/0.037 (0.55/0.95) |
| Ø | 0°/8° (0°/8°) |

## ORDERING INFORMATION

| Model | Temperature Range | Package |
|---|---|---|
| **SP385ACA** | 0°C to +70°C | 20–pin SSOP |
| **SP385AEA** | –40°C to +85°C | 20–pin SSOP |
| **SP385ACT** | 0°C to +70°C | 18–pin SOIC |
| **SP385AET** | –40°C to +85°C | 18–pin SOIC |

CT and ET packages available Tape–on–Reel. Please consult the factory for pricing and availability for this option, and for parts screened to MIL–STD–883.

Sipex Corporation

SIGNAL PROCESSING EXCELLENCE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