

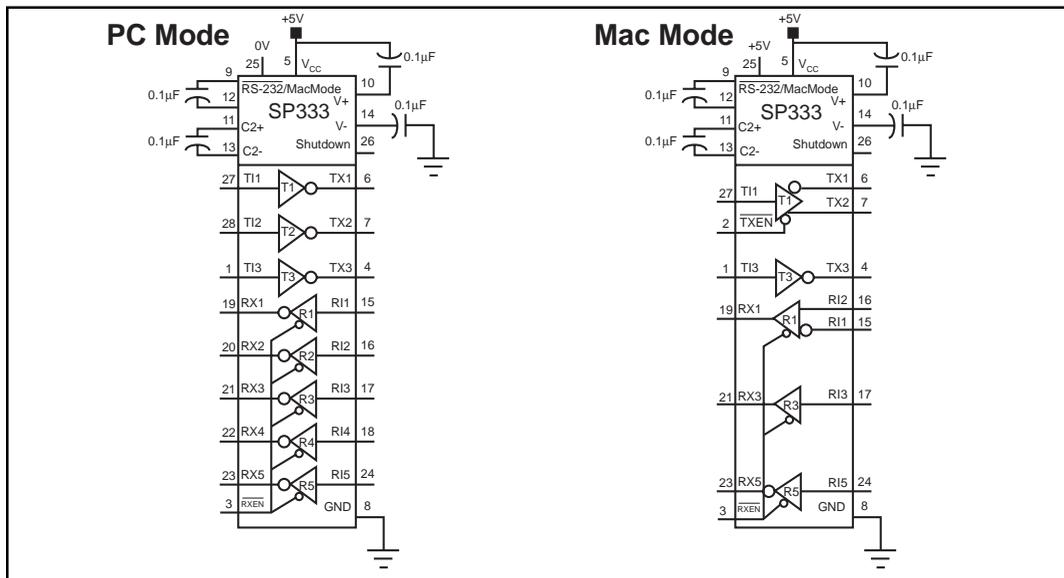
## +5V Only RS-232/AppleTalk™ Programmable Transceiver

- +5V Only, Single Supply Operation
- Low Power Shutdown
- 28-Pin SOIC Packaging
- 3 Drivers, 5 Receivers – RS-232
- Complete AppleTalk™ Interface
- High Data Rates
  - 10Mbps Differential Transceivers
  - 460kpbs Single-Ended Transceivers



### DESCRIPTION...

The **SP333** is a monolithic device that supports both Macintosh™ and PC serial interfaces. RS-232 mode offers three (3) RS-232 drivers and five (5) RS-232 receivers. Mac mode includes a differential driver and a single-ended inverting driver. Receivers in Mac mode include one differential receiver, one non-inverting single-ended receiver and one inverting single-ended receiver. An on-chip charge pump allows +5V-only operation, and a low power Shutdown mode makes the **SP333** ideal for battery powered applications. The interface mode can be changed at any time by a mode select pin.



## 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> .....    | +12V                             |
| Input Voltages           |                                  |
| Logic.....               | -0.3V to (V <sub>CC</sub> +0.5V) |
| Drivers.....             | -0.3V to (V <sub>CC</sub> +0.5V) |
| Receivers.....           | ±15V                             |
| Driver Outputs.....      | ±14V                             |
| Storage Temperature..... | -65°C to +150°C                  |
| Power Dissipation.....   | 1000mW                           |

## SPECIFICATIONS

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

| PARAMETER                            | MIN. | TYP. | MAX. | UNITS | CONDITIONS                                                                              |
|--------------------------------------|------|------|------|-------|-----------------------------------------------------------------------------------------|
| <b>MAC Mode (pin 25 = +5V)</b>       |      |      |      |       |                                                                                         |
| <b>Differential Driver</b>           |      |      |      |       |                                                                                         |
| High Level Output Voltage            | +3.6 |      |      | Volts | I <sub>OH</sub> = 8mA                                                                   |
| Low Level Output Voltage             |      |      | -3.6 | Volts | I <sub>OH</sub> = -8mA                                                                  |
| Differential Output, Load            |      | ±5V  |      | Volts | R <sub>L</sub> = 450Ω (TX outputs to GND)                                               |
| Differential Output, No Load         |      |      | ±10  | Volts | R <sub>L</sub> = ∞                                                                      |
| Driver Short Circuit Current         |      | ±40  | 500  | mA    | -7V ≤ V <sub>O</sub> ≤ +7V; V <sub>IN LOW</sub> ≤ 0.8V or V <sub>IN HIGH</sub> ≥ 2.0V   |
| Output Leakage Current               |      |      | ±100 | μA    | -7V ≤ V <sub>O</sub> ≤ +7V; TxEN = V <sub>CC</sub>                                      |
| Input High Voltage                   | 2.0  |      |      | Volts | Applies to differential driver inputs                                                   |
| Input Low Voltage                    |      |      | 0.8  | Volts | Applies to differential driver inputs                                                   |
| Input Current                        |      |      | ±20  | μA    | V <sub>IN</sub> = 0V to V <sub>CC</sub>                                                 |
| Transition Time                      |      | 30   |      | ns    | R <sub>L</sub> = 450Ω, C <sub>L</sub> = 50pF; Rise/Fall 10% – 90%                       |
| Propagation Delay                    |      |      |      |       |                                                                                         |
| t <sub>PHL</sub>                     |      | 100  |      | ns    | R <sub>L</sub> = 450Ω, C <sub>L</sub> = 50pF                                            |
| t <sub>PLH</sub>                     |      | 100  |      | ns    | R <sub>L</sub> = 450Ω, C <sub>L</sub> = 50pF                                            |
| Data Rate                            | 10   |      |      | Mbps  | R <sub>L</sub> = 450Ω, C <sub>L</sub> = 50pF                                            |
| <b>Single-Ended Inverting Driver</b> |      |      |      |       |                                                                                         |
| High Level Output Voltage            | +3.6 |      | +6.0 | Volts | R <sub>L</sub> = 450Ω to GND; V <sub>IN LOW</sub> ≤ 0.8V or V <sub>IN HIGH</sub> ≥ 2.0V |
| Low Level Output Voltage             | -6.0 |      | -3.6 | Volts | R <sub>L</sub> = 450Ω to GND; V <sub>IN LOW</sub> ≤ 0.8V or V <sub>IN HIGH</sub> ≥ 2.0V |
| Driver Open Circuit Voltage          |      |      | ±10  | Volts | R <sub>L</sub> = ∞                                                                      |
| Driver Short Circuit Current         |      | ±40  |      | mA    | -7V ≤ V <sub>O</sub> ≤ +7V; Infinite duration                                           |
| Input High Voltage                   | 2.0  |      |      | Volts | Applies to single-ended driver inputs                                                   |
| Input Low Voltage                    |      |      | 0.8  | Volts | Applies to single-ended driver inputs                                                   |
| Input Current                        |      |      | ±20  | μA    | V <sub>IN</sub> = 0V to V <sub>CC</sub>                                                 |
| Transition Time                      |      | 30   |      | ns    | R <sub>L</sub> = 450Ω, C <sub>L</sub> = 50pF; Rise/Fall 10% – 90%                       |
| Propagation Delay                    |      |      |      |       |                                                                                         |
| t <sub>PHL</sub>                     |      | 100  |      | ns    | R <sub>L</sub> = 450Ω, C <sub>L</sub> = 50pF                                            |
| t <sub>PLH</sub>                     |      | 100  |      | ns    | R <sub>L</sub> = 450Ω, C <sub>L</sub> = 50pF                                            |
| Data Rate                            | 10   |      |      | Mbps  | R <sub>L</sub> = 450Ω, C <sub>L</sub> = 50pF                                            |
| <b>Differential Receiver</b>         |      |      |      |       |                                                                                         |
| Differential Input Threshold         | -0.2 | 70   | +0.2 | Volts | -7V ≤ V <sub>CM</sub> ≤ +7V                                                             |
| Input Hysteresis                     |      |      |      | mV    | V <sub>CM</sub> = 0V                                                                    |
| Input Resistance                     | 12   |      |      | kΩ    | -7V ≤ V <sub>CM</sub> ≤ +7V                                                             |
| Output Voltage High                  | 3.5  |      |      | Volts | I <sub>SOURCE</sub> = -4mA                                                              |
| Output Voltage Low                   |      |      | 0.4  | Volts | I <sub>SINK</sub> = +4mA                                                                |
| Short Circuit Current                |      |      | 85   | mA    | 0V ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub>                                                 |

## SPECIFICATIONS (CONTINUED)

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

| PARAMETER                                                                                                                                                                                                                                                                                                                                 | MIN.            | TYP.       | MAX.                                          | UNITS                                                                                                           | CONDITIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Differential Receiver</b><br>Propagation Delay<br>$t_{PHL}$<br>$t_{PLH}$<br>Data Rate                                                                                                                                                                                                                                                  |                 | 100<br>100 |                                               | ns<br>ns<br>Mbps                                                                                                | $R_L = 450\Omega$ , $C_L = 50pF$<br>$R_L = 450\Omega$ , $C_L = 50pF$<br>$R_L = 450\Omega$ , $C_L = 50pF$                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Single-Ended Inverting Receiver</b><br>Input Voltage Range<br>Input Threshold Low<br>Input Threshold High<br>Hysteresis<br>Input Impedance<br>Output Voltage High<br>Output Voltage Low<br>Propagation Delay<br>$t_{PHL}$<br>$t_{PLH}$<br>Data Rate                                                                                    | -15<br>0.8      | 1.2<br>1.7 | +15<br>3.0                                    | Volts<br>Volts<br>Volts                                                                                         | $I_{SOURCE} = -4mA$<br>$I_{SINK} = +4mA$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                                                                                                                                                                                                                                                                                           | 200<br>3<br>3.5 | 500<br>5   | 1000<br>7                                     | mV<br>k $\Omega$<br>Volts<br>Volts                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                           |                 | 100<br>100 |                                               | ns<br>ns<br>Mbps                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Single-Ended Non-Inverting Receiver</b><br>Input Voltage Range<br>Input Threshold Low<br>Input Threshold High<br>Hysteresis<br>Input Impedance<br>Output Voltage High<br>Output Voltage Low<br>Propagation Delay<br>$t_{PHL}$<br>$t_{PLH}$<br>Data Rate                                                                                | -7<br>-0.2      | 70<br>15   | +7<br>+0.2                                    | Volts<br>Volts<br>Volts                                                                                         | $I_{SOURCE} = -4mA$<br>$I_{SINK} = +4mA$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                                                                                                                                                                                                                                                                                           | 12<br>3.5       |            |                                               | mV<br>k $\Omega$<br>Volts<br>Volts                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                           |                 | 100<br>100 |                                               | ns<br>ns<br>Mbps                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>PC Mode (pin 25 = GND)</b><br><br><b>RS-232 Driver</b><br>TTL Input Levels<br>$V_{IL}$<br>$V_{IH}$<br>High Level Voltage Output<br>Low Level Voltage Output<br>Open Circuit Output<br>Short Circuit Current<br>Power Off Impedance<br>Slew Rate<br><br>Transition Time<br><br>Propagation Delay<br>$t_{PHL}$<br>$t_{PLH}$<br>Data Rate | 2.0<br>-15.0    | 60         | 0.8<br>+15.0<br>-5.0<br>$\pm 15$<br>$\pm 100$ | Volts<br>Volts<br>Volts<br>Volts<br>Volts<br>mA<br>Ohms<br>V/ $\mu s$<br><br>$\mu s$<br><br>$\mu s$<br><br>kbps | Applies to transmitter inputs<br>Applies to transmitter inputs<br>$R_L = 3k\Omega$ to Gnd<br>$R_L = 3k\Omega$ to Gnd<br>$R_L = \infty$<br>$V_{OUT} = Gnd$<br>$V_{CC} = 0V$ ; $V_{OUT} = \pm 2V$<br>$R_L = 3k\Omega$ , $C_L = 50pF$ ; From +3V to -3V or -3V to +3V<br>Rise/fall time, between +3V & -3V ; $R_L = 3k\Omega$ , $C_L = 2500pF$<br><br>$R_L = 3k\Omega$ , $C_L = 1000pF$ ; From 1.5V of $T_{IN}$ to 50% of $V_{OUT}$<br>$R_L = 3k\Omega$ , $C_L = 1000pF$ ; From 1.5V of $T_{IN}$ to 50% of $V_{OUT}$<br>$R_L = 3k\Omega$ , $C_L = 1000pF$ |
| <b>RS-232 Receiver</b><br>TTL Output Levels<br>$V_{OL}$<br>$V_{OH}$<br>Receiver Input<br>High Threshold                                                                                                                                                                                                                                   | 2.4             | 1.7        | 0.4<br>3.0                                    | Volts<br>Volts                                                                                                  | $I_{SINK} = 4mA$<br>$I_{SOURCE} = -4mA$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

# SPECIFICATIONS (CONTINUED)

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

| PARAMETER                                                     | MIN.                                                      | TYP. | MAX. | UNITS   | CONDITIONS                                    |
|---------------------------------------------------------------|-----------------------------------------------------------|------|------|---------|-----------------------------------------------|
| <b>RS-232 Receiver</b>                                        |                                                           |      |      |         |                                               |
| Low Threshold                                                 | 0.8                                                       | 1.2  |      | Volts   | $V_{IN} = \pm 15V$<br>$V_{CC} = +5V$          |
| Input Voltage Range                                           | -15                                                       |      | +15  | Volts   |                                               |
| Input Impedance                                               | 3                                                         | 5    | 7    | kOhms   |                                               |
| Hysteresis                                                    | 0.2                                                       | 0.5  | 1.0  | Volts   |                                               |
| Transmission Rate                                             | 10                                                        |      |      | Mbps    |                                               |
| Propagation Delay                                             |                                                           | 100  | 600  | ns      |                                               |
| $t_{PHL}$                                                     |                                                           | 100  | 600  | ns      | From 50% of $V_{IN}$ to 1.5V of $R_{OUT}$     |
| $t_{PLH}$                                                     |                                                           | 100  | 600  | ns      |                                               |
| Data Rate                                                     | 460                                                       | 600  |      | kbps    |                                               |
| <b>POWER REQUIREMENTS</b>                                     |                                                           |      |      |         |                                               |
| No Load Supply Current                                        |                                                           | 15   | 25   | mA      | No load; $V_{CC} = 5.0V$ ; $T_A = 25^\circ C$ |
| Shutdown Supply Current                                       |                                                           |      | 75   | $\mu A$ | $T_A = 25^\circ C$ ; $V_{CC} = 5.0V$          |
| <b>AC PARAMETERS</b>                                          |                                                           |      |      |         |                                               |
| <b>Differential Mode</b>                                      |                                                           |      |      |         |                                               |
| $t_{PZL}$ ; Enable to Output low                              |                                                           | 200  | 1000 | ns      | $C_L = 100pF$ , Figures 2 & 4, $S_2$ closed   |
| $t_{PZH}$ ; Enable to Output high                             |                                                           | 200  | 1000 | ns      | $C_L = 100pF$ , Figures 2 & 4, $S_1$ closed   |
| $t_{PLZ}$ ; Disable from Output low                           |                                                           | 200  | 1000 | ns      | $C_L = 15pF$ , Figures 2 & 4, $S_2$ closed    |
| $t_{PHZ}$ ; Disable from Output high                          |                                                           | 200  | 1000 | ns      | $C_L = 15pF$ , Figures 2 & 4, $S_1$ closed    |
| <b>Receiver Delay Time from Enable Mode to Tri-state Mode</b> |                                                           |      |      |         |                                               |
| <b>Single-Ended Mode</b>                                      |                                                           |      |      |         |                                               |
| $t_{PZL}$ ; Enable to Output low                              |                                                           | 200  | 1000 | ns      | $C_{RL} = 15pF$ , Figures 1 & 6, $S_1$ closed |
| $t_{PZH}$ ; Enable to Output high                             |                                                           | 200  | 1000 | ns      | $C_{RL} = 15pF$ , Figures 1 & 6, $S_2$ closed |
| $t_{PLZ}$ ; Disable from Output low                           |                                                           | 200  | 1000 | ns      | $C_{RL} = 15pF$ , Figures 1 & 6, $S_1$ closed |
| $t_{PHZ}$ ; Disable from Output high                          |                                                           | 200  | 1000 | ns      | $C_{RL} = 15pF$ , Figures 1 & 6, $S_2$ closed |
| <b>Differential Mode</b>                                      |                                                           |      |      |         |                                               |
| $t_{PZL}$ ; Enable to Output low                              |                                                           | 200  | 1000 | ns      | $C_{RL} = 15pF$ , Figures 1 & 6, $S_1$ closed |
| $t_{PZH}$ ; Enable to Output high                             |                                                           | 200  | 1000 | ns      | $C_{RL} = 15pF$ , Figures 1 & 6, $S_2$ closed |
| $t_{PLZ}$ ; Disable from Output low                           |                                                           | 200  | 1000 | ns      | $C_{RL} = 15pF$ , Figures 1 & 6, $S_1$ closed |
| $t_{PHZ}$ ; Disable from Output high                          |                                                           | 200  | 1000 | ns      | $C_{RL} = 15pF$ , Figures 1 & 6, $S_2$ closed |
| Notes:                                                        |                                                           |      |      |         |                                               |
| 1.                                                            | Measured from 2.5V of $R_{IN}$ to 2.5V of $R_{OUT}$ .     |      |      |         |                                               |
| 2.                                                            | Measured from one-half of $R_{IN}$ to 2.5V of $R_{OUT}$ . |      |      |         |                                               |
| 3.                                                            | Measured from 1.5V of $T_{IN}$ to one-half of $T_{OUT}$ . |      |      |         |                                               |
| 4.                                                            | Measured from 2.5V of $R_O$ to 0V of A and B.             |      |      |         |                                               |

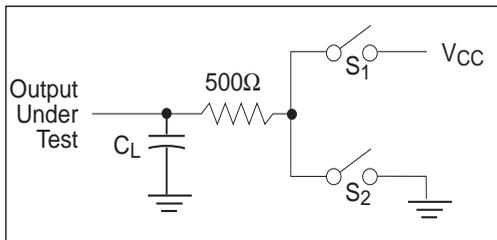


Figure 1. Driver Timing Test Load Circuit

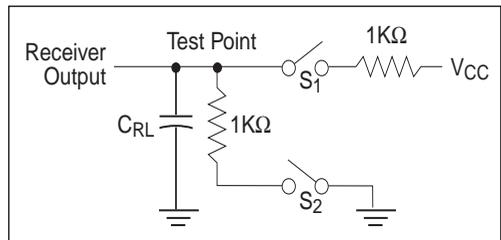


Figure 2. Receiver Timing Test Load Circuit

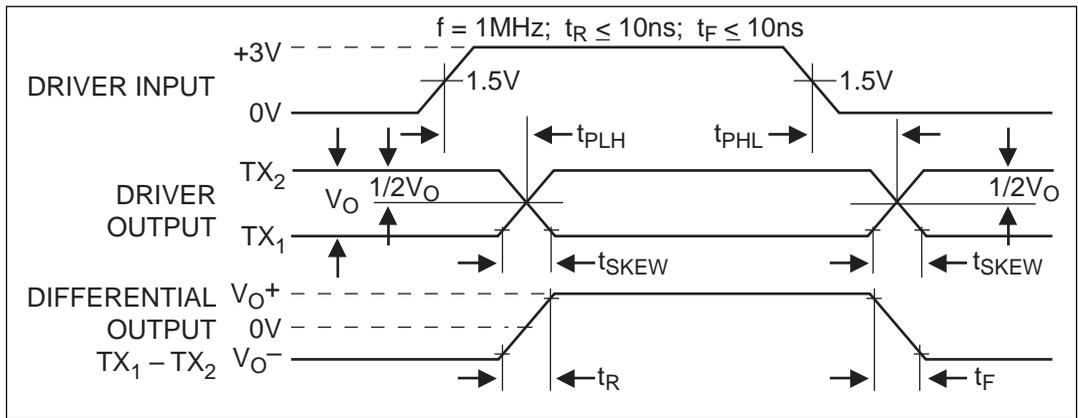


Figure 3. Driver Propagation Delays

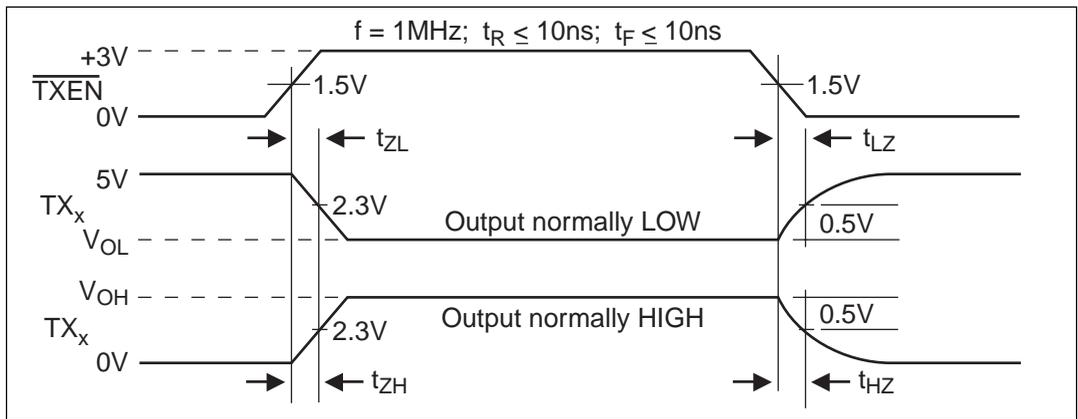


Figure 4. Driver Enable and Disable Times

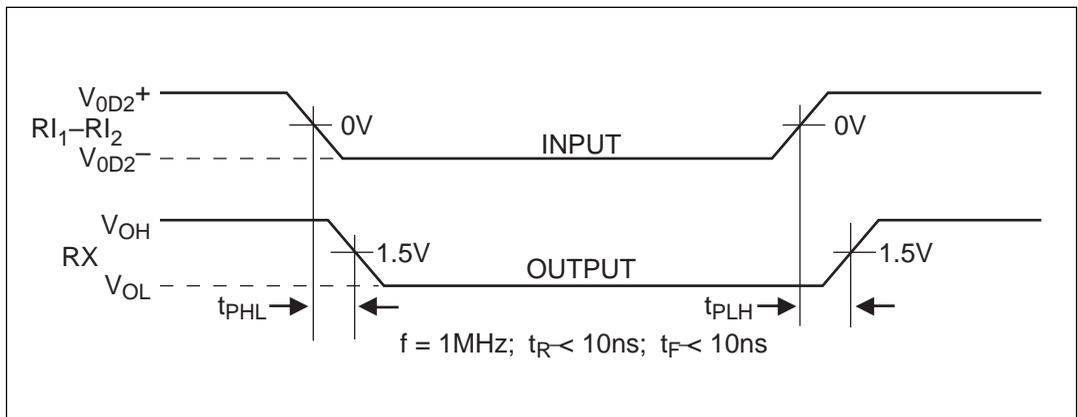


Figure 5. Receiver Propagation Delays

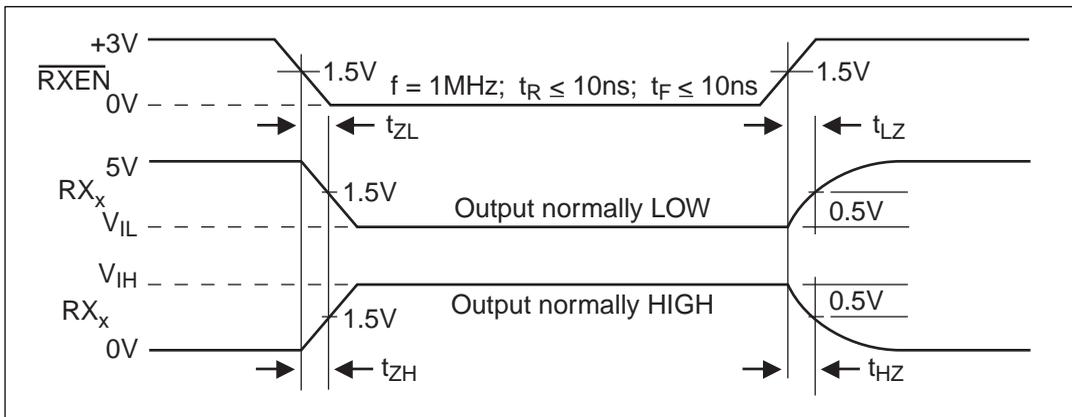


Figure 6. Receiver Enable and Disable Times

## THEORY OF OPERATION...

The **SP333** is a single chip device that can be configured via software for either RS-232 or AppleTalk™ interface modes at any time. The **SP333** is made up of three basic circuit elements: single-ended drivers and receivers, differential drivers and receivers, and charge pump.

## APPLETALK™ DRIVERS/RECEIVERS...

To program the **SP333** for MacMode, Pin 25 should be connected to a logic HIGH. In MacMode, the **SP333** offers a complete AppleTalk serial interface.

The driver section of the AppleTalk interface is made up of a differential driver and a single-ended inverting driver. The differential driver has voltage swings that are typically  $\pm 5V$  on each output pin under loaded conditions, and typically  $\pm 8V$  under no-load conditions. The differential driver can maintain  $\pm 3.6V$  (minimum) swings (per pin) under worst case load conditions of  $450\Omega$  between the differential output.

The differential driver is equipped with a tri-state control pin. When  $\overline{TXEN}$  is a logic LOW, the differential driver is active. When the  $\overline{TXEN}$  pin is a logic HIGH, the differential driver outputs are tri-stated. The  $\overline{TXEN}$  pin only functions in MacMode. The differential AppleTalk driver can support data rates up to 10Mbps.

The single-ended AppleTalk driver also has typical voltage output swings of  $\pm 5V$  under loaded conditions, and  $\pm 8V$  under no-load conditions. The single-ended AppleTalk driver can maintain  $\pm 3.6V$  (minimum) swings under worst case conditions of  $450\Omega$  to ground. The single-ended AppleTalk driver can support data rates over 400kbps.

The receiver section of the **SP333** is made up of a differential receiver, a single-ended non-inverting receiver, and a single-ended inverting receiver. The differential receiver has an input sensitivity of  $\pm 200mV$  over a common mode range of  $\pm 7V$ . The receivers have a typical input resistance of  $15k\Omega$  ( $12k\Omega$  minimum). The differential receiver can receive data up to 10Mbps.

The single-ended non-inverting receiver has a  $\pm 200mV$  input threshold, however, the input voltage can vary between  $\pm 7V$ . The typical input resistance of the single-ended non-inverting receiver is  $15k\Omega$  ( $12k\Omega$  minimum). The single-ended non-inverting receiver can also receive data up to 10Mbps.

The **SP333** also has a single-ended inverting receiver input. This receiver is basically an RS-232 receiver (R5 receiver) and is typically used as a GPI (General Purpose Input) in the AppleTalk interface. The GPI input has TTL-compatible input thresholds that can receive

signals up to  $\pm 15V$ . The input resistance of the single-ended inverting receiver is typically  $5k\Omega$  ( $3k\Omega$  to  $7k\Omega$ ). The GPI receiver can operate up to 10Mbps.

## SINGLE ENDED DRIVERS/RECEIVERS...

### RS-232 (V.28) Drivers...

The single-ended drivers and receivers comply with the RS-232E and V.28 standards. The drivers are inverting transmitters which accept either TTL or CMOS inputs and output the RS-232 signals with an inverted sense relative to the input logic levels. Typically, the RS-232 driver output voltage swing is  $\pm 9V$  with no load and is guaranteed to be greater than  $\pm 5V$  under full load. The drivers rely on the  $V+$  and  $V-$  voltages generated by the on-chip charge pump to maintain proper RS-232 output levels. With worst case load conditions of  $3k\Omega$  and  $2500pF$ , the four RS-232 drivers can still maintain  $\pm 5V$  output levels. The drivers can operate over 400kbps; the propagation delay from input to output is typically  $1.5\mu s$ . During shutdown, the driver outputs will be put into a high impedance tri-state mode.

### RS-232 (V.28) Receivers...

The RS-232 receivers convert RS-232 input signals to inverted TTL signals. Each of the four

receivers features 500mV of hysteresis margin to minimize the affects of noisy transmission lines. The inputs also have a  $5k\Omega$  resistor to ground, in an open circuit situation the input of the receiver will be forced low, committing the output to a logic HIGH state. The input resistance will maintain  $3k\Omega$ - $7k\Omega$  over a  $\pm 15V$  range. The maximum operating voltage range for the receiver is  $\pm 30V$ , under these conditions the input current to the receiver must be limited to less than 100mA. Due to the on-chip ESD protection circuitry, the receiver inputs will be clamped to  $\pm 15V$  levels; this should not affect operation at  $\pm 30V$ olts. The RS-232 receivers can operate over 400kbps.

## CHARGE PUMP...

The charge pump is a Sipex-patented design (5,306,954) and uses a unique approach compared to older less-efficient designs. The charge pump still requires four external capacitors, but uses a four-phase voltage shifting technique to attain symmetrical 10V power supplies. The capacitor values of the **SP333** can be as low as  $0.1\mu F$ . *Figure 11a* shows the waveform found on the positive side of capacitor  $C_2$ , and *Figure 11b* shows the negative side of capacitor  $C_2$ . There is a free-running oscillator that controls the four phases of the voltage shifting. A description of each phase follows.

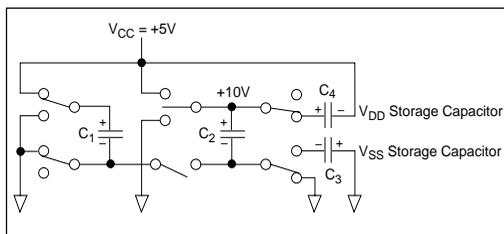


Figure 7. Charge Pump Phase 1

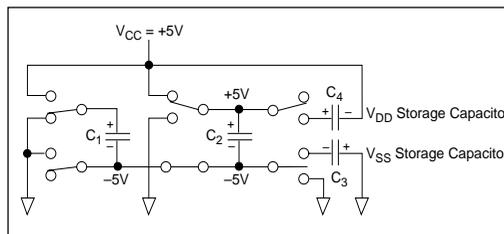


Figure 8. Charge Pump Phase 2

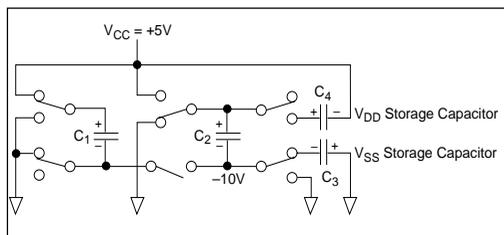


Figure 9. Charge Pump Phase 3

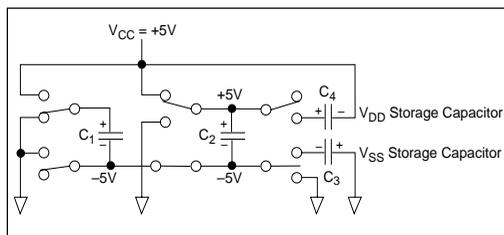


Figure 10. Charge Pump Phase 4

### Phase 1

-V<sub>ss</sub> charge storage- During this phase of the clock cycle, the positive side of capacitors C1 and C2 are initially charged to +5V. C1+ is then switched to ground and charge in C1- is transferred to C2-. Since C2+ is connected to +5V, the voltage potential across capacitor C2 is now 10V.

### Phase 2

-V<sub>ss</sub> transfer- Phase two of the clock connects the negative terminal of C2 to the V<sub>ss</sub> storage capacitor and the positive terminal of C2 to ground, and transfers the generated -10V to C3. Simultaneously, the positive side of capacitor C1 is switched to +5V and the negative side is connected to ground.

### Phase 3

-V<sub>dd</sub> charge storage- The third phase of the clock is identical to the first phase- the transferred charge in C1 produces -5V in the negative terminal of C1, which is applied to the negative side of capacitor C2. Since C2+ is at +5V, the voltage potential across C2 is 10V.

### Phase 4

-V<sub>dd</sub> transfer- The fourth phase of the clock connects the negative terminal of C2 to ground and transfers the generated 10V across C2 to C4,

the V<sub>dd</sub> storage capacitor. Simultaneously with this, the positive side of capacitor C1 is switched to +5V and the negative side is connected to ground, and the cycle begins again.

Since both V<sub>+</sub> and V<sub>-</sub> are separately generated from V<sub>cc</sub> in a no load condition, V<sub>+</sub> and V<sub>-</sub> will be symmetrical. Older charge pump approaches that generate V<sub>-</sub> from V<sub>+</sub> will show a decrease in the magnitude of V<sub>-</sub> compared to V<sub>+</sub> due to the inherent inefficiencies in the design.

The clock rate for the charge pump typically operates at 15kHz. The external capacitors should be 0.1μF with a 16V breakdown rating.

### External Power Supplies

For applications that do not require +5V only, external supplies can be applied at the V<sub>+</sub> and V<sub>-</sub> pins. The value of the external supply voltages must be no greater than ±10V. The current drain from the ±10V supplies is used for the RS-232 drivers. For the RS-232 driver, the current requirement is 3.5mA per driver. The external power supplies should provide a power supply sequence of either: +10V, -10V, and then +5V; or -10V, +10V, and then +5V. It is critical that the ±10V supplies are on before V<sub>cc</sub>.

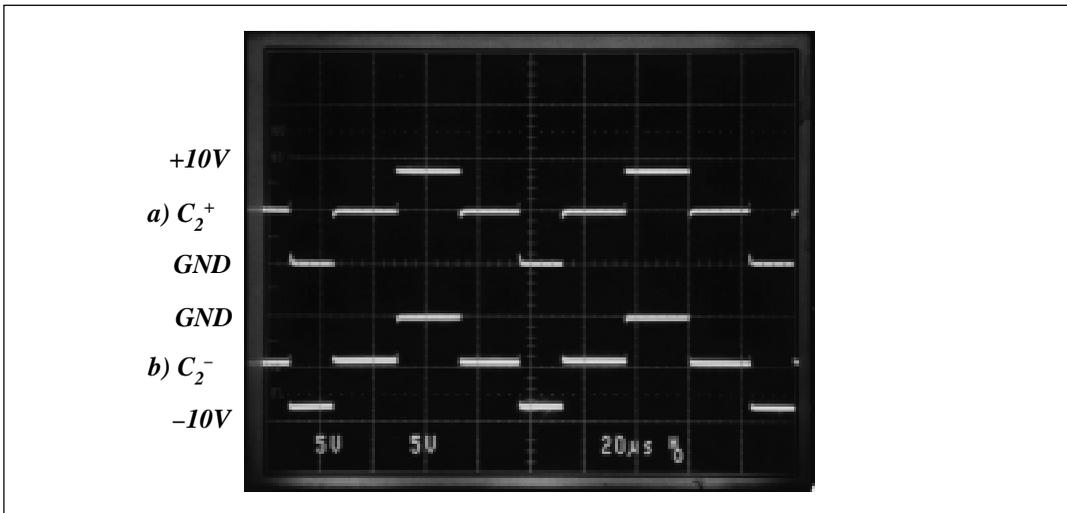


Figure 11. Charge Pump Waveforms

## Shutdown Mode

The **SP333** can be put into a low power shutdown mode by connecting the Shutdown pin (SD, Pin 26) to a logic HIGH. During Shutdown, the driver outputs are put into a high impedance tri-state, and the charge pump is put into stand-by mode. The supply current drops to less than 10 $\mu$ A during shutdown and can be activated in either RS-232 or AppleTalk mode. For normal operation, the SD pin should be connected to a logic LOW.

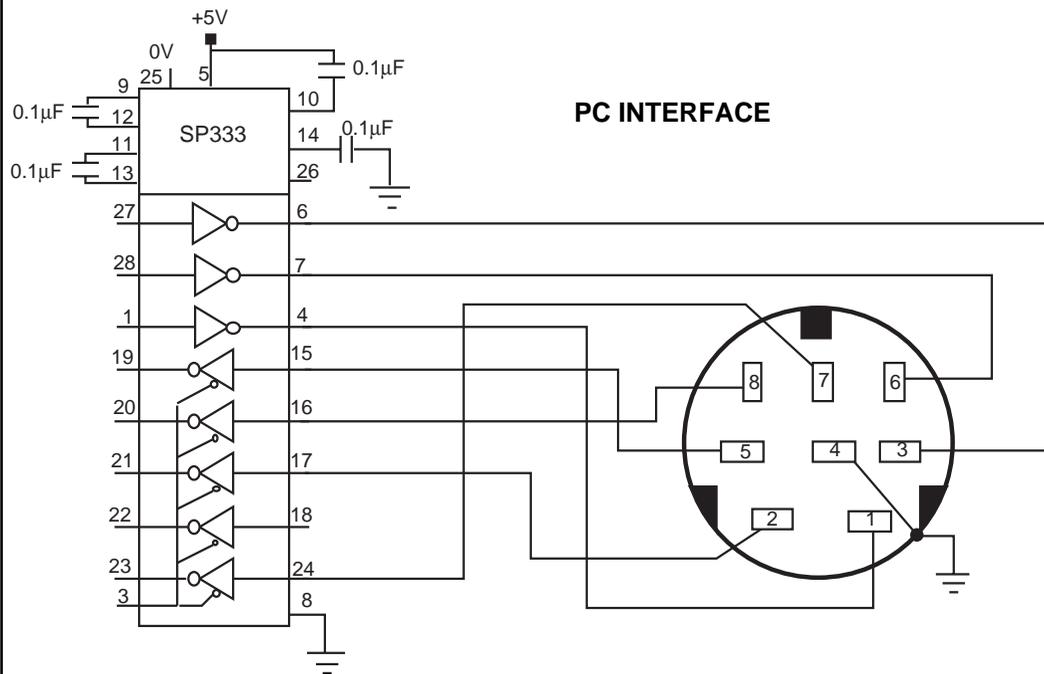
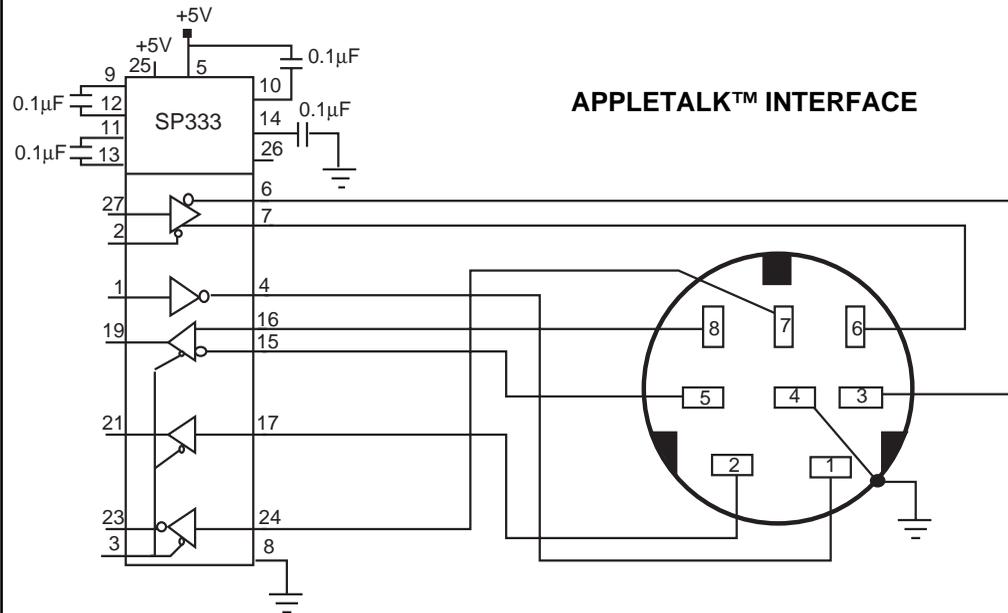
## Receiver Enable

The **SP333** has a control line to enable or disable the receiver outputs. Pin 3 (RXEN) is active LOW; a logic LOW on Pin 3 will enable the receiver outputs. A logic HIGH on Pin 3 will disable the receiver outputs. The receiver enable function can be initiated in either RS-232 or AppleTalk mode.

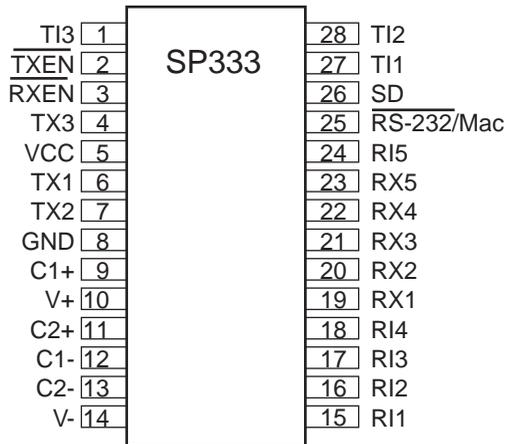
## Wake-Up

The **SP333** also features a "wake-up" function. The wake up function allows the RS-232 receivers to remain active during Shutdown mode unless they are disabled by the Receiver Enable control pin (Pin 3). The wake-up feature allows users to take advantage of the low power Shutdown mode and keep the receivers active to accept an incoming "ring indicator" signal.

# SP333 Typical Application for AppleTalk™ and RS-232

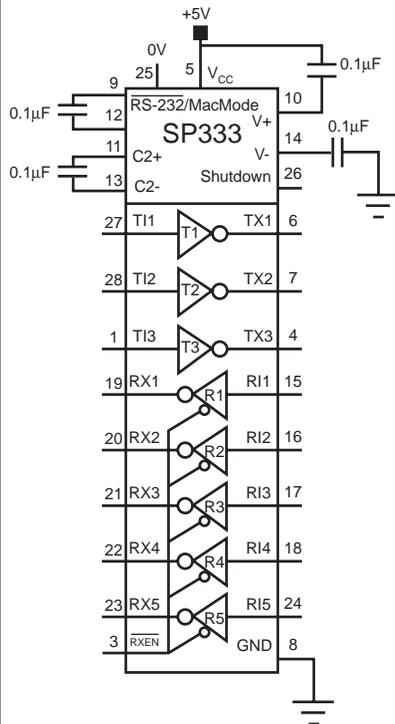


## SP333 PIN CONFIGURATION

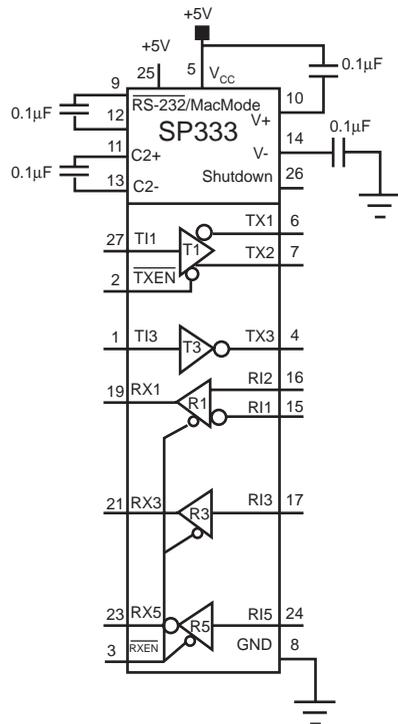


## SP333 TYPICAL OPERATING CIRCUIT

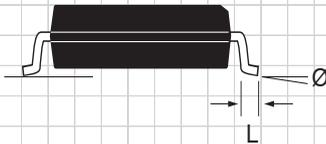
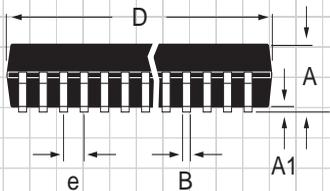
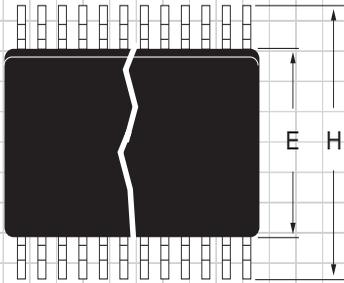
### PC Mode (RS-232)



### Mac Mode (AppleTalk)



**PACKAGE: PLASTIC  
SMALL OUTLINE (SOIC)**



| DIMENSIONS (Inches)<br>Minimum/Maximum<br>(mm) | 28-PIN                       |
|------------------------------------------------|------------------------------|
| A                                              | 0.093/0.104<br>(2.352/2.649) |
| A1                                             | 0.004/0.012<br>(0.102/0.300) |
| B                                              | 0.013/0.020<br>(0.330/0.508) |
| D                                              | 0.697/0.713<br>(17.70/18.09) |
| E                                              | 0.291/0.299<br>(7.402/7.600) |
| e                                              | 0.050 BSC<br>(1.270 BSC)     |
| H                                              | 0.394/0.419<br>(10.00/10.64) |
| L                                              | 0.016/0.050<br>(0.406/1.270) |
| Ø                                              | 0°/8°<br>(0°/8°)             |

## ORDERING INFORMATION

| Model         | Temperature Range    | Package Types |
|---------------|----------------------|---------------|
| SP333CT ..... | 0°C to +70°C .....   | 28-Pin SOIC   |
| SP333ET ..... | -40°C to +85°C ..... | 28-Pin SOIC   |



SIGNAL PROCESSING EXCELLENCE

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