



## GENERAL DESCRIPTION

The **SP337E** is a dual mode RS-232/RS-485/RS-422 serial transceiver containing both RS-232 and RS-485 line drivers and receivers. The RS-232 mode provides three drivers and five receivers to support all eight signals commonly used in the DB9 serial port connector (3TX/5RX). In RS-485 mode the device features two independent high speed RS-485 /422 transmit and receive channels (2TX/2RX). The default RS-485 configuration is full-duplex, but half-duplex operation can be obtained by tying together the TX and RI pins, and the TXEN and RXEN signals. The SP337 is pin compatible to Exar's SP334.

The **SP337EB** features a maximum data rate of 250kbps in RS-232 mode and a maximum data rate of 15Mbps in RS-485. However, the **SP337EU** features a maximum data rate of 1Mbps in RS-232 mode and a maximum data rate of 15Mbps in RS-485 mode.

The **Exar**-patented high efficiency charge pumps (5,306,954) deliver true RS-232 driver output voltages from a single power supply from 3.3V to 5V. Charge pump outputs are self-monitored to minimize power consumption. The **SP337E** requires only four 0.1 $\mu$ F capacitors for complete functionality.

All RS-485 receivers or transceivers feature high impedance inputs which allow up to 256 transceivers on a single shared bus. When configured in RS-485/RS-422 mode, each driver may be individually enabled or put into tri-state, simplifying use on shared buses or for bidirectional communication. The RS-485 drivers can be disabled (high-Z output) by the TXEN enable pin. The RS-232 receiver outputs can be disabled by the RXEN enable pin.

All receivers have advanced failsafe protection to prevent oscillation when inputs are un-connected. In RS-232 mode, each receiver input has a 5k $\Omega$  pull-down to ground. in RS-485/RS-422 mode, receivers will default to output logic 1 if inputs are floating, shorted, or open but terminated.

All driver outputs and receiver inputs are protected against ESD strikes up to +/-15,000 volts.

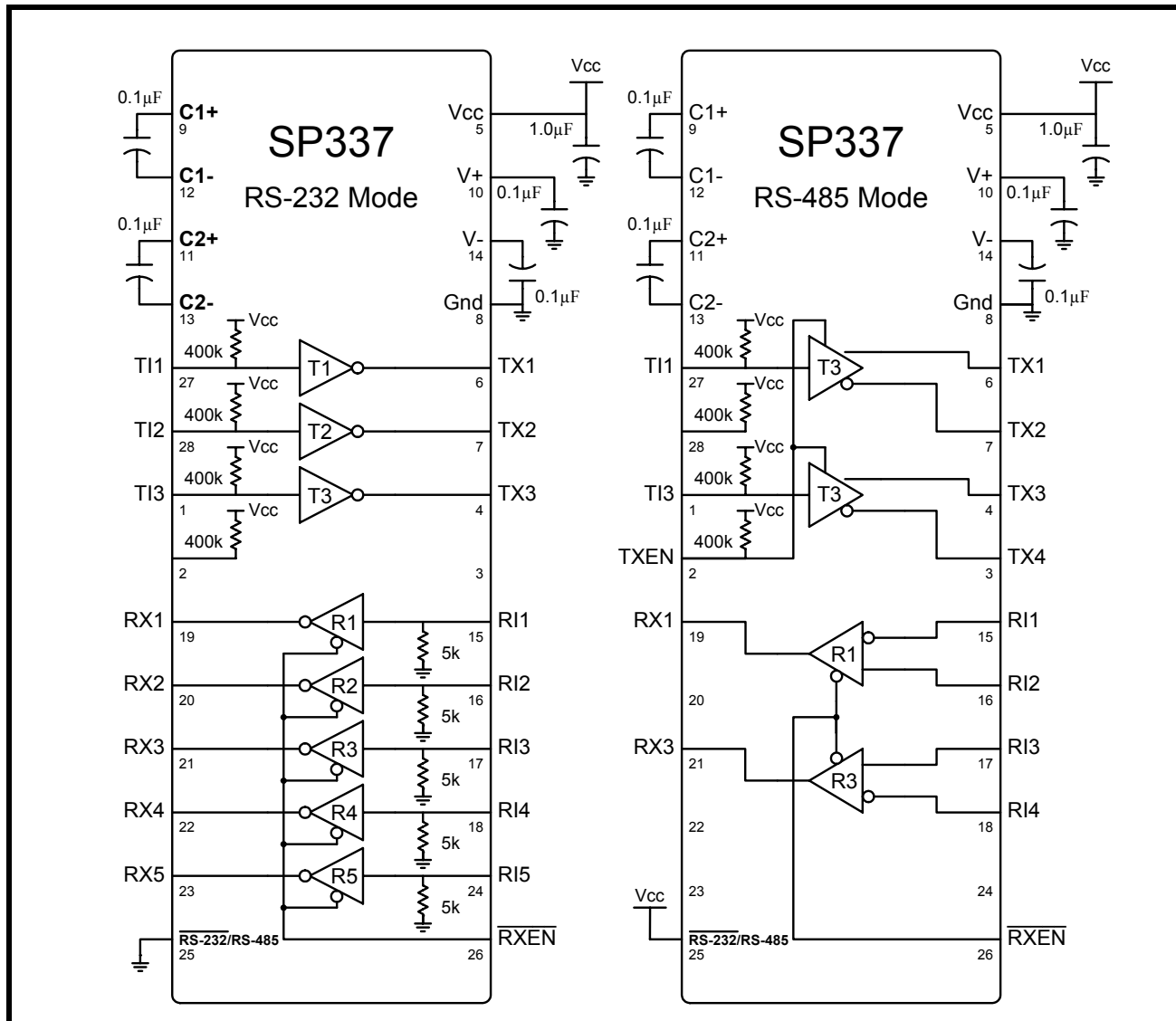
## FEATURES

- 3.3V to 5V Single Supply Operation
- Robust +/-15kV ESD Protection
  - Human Body Model
- Max Data Rate of 15Mbps in RS-485/422 and up to 1Mbps in RS-232 Mode (SP337EU)
- 3 Drivers, 5 Receivers RS-232/V.28
- 2 Drivers, 2 Receivers RS-485/RS-422
  - Full-Duplex Configuration
  - 1/8th Unit Load, up to 256 receivers on bus
- RS-485 Advanced Failsafe on Open, Short or Terminated Lines
- Full Differential Driver Tri-State (Hi-Z) Control
- Receiver Output Tri-State Control
- WSOIC-28 or TSSOP-28 Package

## TYPICAL APPLICATIONS

- Dual Protocol Serial Ports (RS-232 or RS-485)
- Industrial Computers
- Industrial and Process Control Equipment
- Point-Of-Sales Equipment
- Networking Equipment
- HVAC Controls Equipment
- Building Security Equipment

FIGURE 1. TYPICAL RS-232 AND RS-485 APPLICATION CIRCUITS



## ORDERING INFORMATION

| PART NUMBER | PACKAGE       | OPERATING TEMPERATURE RANGE | DEVICE STATUS |
|-------------|---------------|-----------------------------|---------------|
| SP337EBCT-L | 28-pin SOIC-W | 0°C to +70°C                | Active        |
| SP337EBCY-L | 28-pin TSSOP  | 0°C to +70°C                | Active        |
| SP337EBET-L | 28-pin SOIC-W | -40°C to +85°C              | Active        |
| SP337EBEY-L | 28-pin TSSOP  | -40°C to +85°C              | Active        |
| SP337EUCT-L | 28-pin SOIC-W | 0°C to +70°C                | Active        |
| SP337EUCY-L | 28-pin TSSOP  | 0°C to +70°C                | Active        |
| SP337EUET-L | 28-pin SOIC-W | -40°C to +85°C              | Active        |
| SP337EUEY-L | 28-pin TSSOP  | -40°C to +85°C              | Active        |

## PIN DESCRIPTIONS

### Pin Assignments

| PIN # | PIN NAME    | TYPE   | DESCRIPTION                                                                                                               |                                    |
|-------|-------------|--------|---------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|       |             |        | RS-232                                                                                                                    | RS-485/RS-422                      |
| 1     | TI3         | Input  | T3 Driver TTL input                                                                                                       | T3 Driver TTL input                |
|       |             |        | This pin has a 400k pull-up to Vcc in both RS-232 and RS-485 modes. The pull-up is disabled in the SP337EU shutdown mode. |                                    |
| 2     | TXEN        | Input  | X                                                                                                                         | Only RS-485 mode                   |
|       |             |        | This pin has a 400k pull-up to Vcc in both RS-232 and RS-485 modes. The pull-up is disabled in the SP337EU shutdown mode. |                                    |
| 3     | TX4         | Output | X                                                                                                                         | T3(Z) Inverting Output             |
| 4     | TX3         | Output | T3 Driver Output                                                                                                          | T3(Y) Non-Inverting Output         |
| 5     | Vcc         | Power  | Power Supply Voltage, between 3.3V and 5V                                                                                 |                                    |
| 6     | TX1         | Output | T1 Driver Output                                                                                                          | T1(Y) Non-Inverting Output         |
| 7     | TX2         | Output | T2 Driver Output                                                                                                          | T1(Z) Inverting Output             |
| 8     | GND         | Power  | Ground                                                                                                                    |                                    |
| 9     | C1+         | Pump   | Positive Terminal of Positive Flying Capacitor                                                                            |                                    |
| 10    | V+          | Pump   | Vdd Storage Capacitor                                                                                                     |                                    |
| 11    | C2+         | Pump   | Positive Terminal of Negative Flying Capacitor                                                                            |                                    |
| 12    | C1-         | Pump   | Negative Terminal of Positive Flying Capacitor                                                                            |                                    |
| 13    | C2-         | Pump   | Negative Terminal of Negative Flying Capacitor                                                                            |                                    |
| 14    | V-          | Pump   | Vss Storage Capacitor                                                                                                     |                                    |
| 15    | RI1         | Input  | R1 Receiver Input, 5k pull-down                                                                                           | R1(B) Receiver Inverting Input     |
| 16    | RI2         | Input  | R2 Receiver Input, 5k pull-down                                                                                           | R1(A) Receiver Non-Inverting Input |
| 17    | RI3         | Input  | R3 Receiver Input, 5k pull-down                                                                                           | R3(A) Receiver Non-Inverting Input |
| 18    | RI4         | Input  | R4 Receiver Input, 5k pull-down                                                                                           | R3(B) Receiver Inverting Input     |
| 19    | RX1         | Output | R1 Receiver Output                                                                                                        |                                    |
| 20    | RX2         | Output | R2 Receiver Output                                                                                                        | X                                  |
| 21    | RX3         | Output | R3 Receiver Output                                                                                                        |                                    |
| 22    | RX4         | Output | R4 Receiver Output                                                                                                        | X                                  |
| 23    | RX5         | Output | R5 Receiver Output                                                                                                        | X                                  |
| 24    | RI5         | Input  | R5 Receiver Input, 5k pull-down                                                                                           | X                                  |
| 25    | RS232/RS485 | Input  | Mode select, either RS-232 (low) or RS-485/422 (high) mode                                                                |                                    |
| 26    | RXEN        | Input  | Receiver enable for both RS-232 and RS-485/422 mode (Active low)                                                          |                                    |

**Pin Assignments**

| PIN # | PIN NAME | TYPE  | DESCRIPTION                                                                                                                  |                 |
|-------|----------|-------|------------------------------------------------------------------------------------------------------------------------------|-----------------|
|       |          |       | RS-232                                                                                                                       | RS-485/RS-422   |
| 27    | TI1      | Input | T1 Driver Input                                                                                                              | T1 Driver Input |
|       |          |       | This pin has a 400k pull-up to Vcc in both RS-232 and RS-485 modes.<br>The pull-up is disabled in the SP337EU shutdown mode. |                 |
| 28    | TI2      | Input | T2 Driver Input                                                                                                              | X               |
|       |          |       | This pin has a 400k pull-up to Vcc in both RS-232 and RS-485 modes.<br>The pull-up is disabled in the SP337EU shutdown mode. |                 |

Pins marked with an X in the above table are ignored or "don't care" in the listed mode, provided they do not exceed Vcc or go below ground. Some of these pins have a pull-up to Vcc which remains active in both RS-232 and RS-485/422 mode, but is disabled in the SP337EU shutdown mode.

## 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 to the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability and cause permanent damage to the device.

|                                                                 |                          |
|-----------------------------------------------------------------|--------------------------|
| Supply Voltage $V_{CC}$                                         | +6.0V                    |
| Receiver Input $V_{IN}$ (DC Input Voltage)                      | -16V to +16V             |
| Input Voltage at TTL input Pins                                 | -0.3V to $V_{CC} + 0.5V$ |
| Driver Output Voltage (from Ground)                             | -7.5V to +12.5V          |
| Short Circuit Duration, TXout to GND                            | Continuous               |
| Storage Temperature Range                                       | -65°C to +150°C          |
| Lead Temperature (soldering, 10s)                               | +300°C                   |
| Power Dissipation 28-pin SOIC-W<br>(derate 17mW/°C above +70°C) | 938mW                    |
| Power Dissipation 28-pin TSSOP<br>(derate 12mW/°C above +70°C)  | 657mW                    |

### CAUTION:

ESD (Electrostatic Discharge) sensitive device. Permanent damage may occur on unconnected devices subject to high energy electrostatic fields. Unused devices must be stored in conductive foam or shunts. Personnel should be properly grounded prior to handling this device. The protective foam should be discharged to the destination socket before devices are removed.

## ELECTRICAL CHARACTERISTICS

**UNLESS OTHERWISE NOTED:  $V_{CC} = +3.3V \pm 5\%$  OR  $+5.0V \pm 5\%$ ,  $C1-C4 = 0.1\mu F$ ;  $T_A = T_{MIN}$  TO  $T_{MAX}$ . TYPICAL VALUES ARE AT  $V_{CC} = 3.3V$ ,  $T_A = +25^\circ C$ .**

| SYMBOL                                                                 | PARAMETERS                                  | MIN.         | TYP. | MAX. | UNITS   | CONDITIONS                                   |
|------------------------------------------------------------------------|---------------------------------------------|--------------|------|------|---------|----------------------------------------------|
| <b>DC CHARACTERISTICS</b>                                              |                                             |              |      |      |         |                                              |
| $I_{CC}$                                                               | Supply Current (RS-232)                     |              | 1.5  | 6.0  | mA      | No Load, RS232/RS485 = 0V                    |
| $I_{CC}$                                                               | Supply Current (RS-485)                     |              | 7.0  | 15   | mA      | No Load, RS232/RS485 = $V_{CC}$              |
| $I_{CC}$                                                               | $V_{CC}$ Shutdown Current<br>(SP337EU only) |              | 1.0  | 10.0 | $\mu A$ | TXEN = 0V, RXEN = $V_{CC}$<br>(SP337EU only) |
| <b>TRANSMITTER and LOGIC INPUT PINS: Pins 1, 2, 25, 26, 27, 28</b>     |                                             |              |      |      |         |                                              |
| $V_{IH}$                                                               | Logic Input Voltage HIGH                    | 2.0          |      |      | V       | $V_{CC} = 3.3V$                              |
| $V_{IH}$                                                               | Logic Input Voltage HIGH                    | 2.4          |      |      | V       | $V_{CC} = 5.0V$                              |
| $V_{IL}$                                                               | Logic Input Voltage LOW                     |              |      | 0.8  | V       |                                              |
| $I_{IL}$                                                               | Logic Input Leakage Current                 |              |      | 1.0  | $\mu A$ | Input High ( $V_{in} = V_{CC}$ )             |
| $I_{PU}$                                                               | Logic Input Pull-up Current                 |              |      | 15.0 | $\mu A$ | Input Low ( $V_{in} = 0V$ )                  |
| $V_{HYS}$                                                              | Logic Input Hysteresis                      |              | 0.5  |      | V       |                                              |
| <b>RS-232 and RS-485/422 RECEIVER OUTPUTS: Pins 19, 20, 21, 22, 23</b> |                                             |              |      |      |         |                                              |
| $V_{OH}$                                                               | Receiver Output Voltage HIGH                | $V_{CC}-0.6$ |      |      | V       | $I_{OUT} = 1.0mA$                            |
| $V_{OL}$                                                               | Receiver Output Voltage LOW                 |              |      | 0.4  | V       | $I_{OUT} = -3.2mA$                           |

## 3.3V TO 5V RS-232/RS-485/RS-422 MULTIPROTOCOL TRANSCEIVER

REV. 1.0.1

UNLESS OTHERWISE NOTED:  $V_{CC} = +3.3V \pm 5\%$  OR  $+5.0V \pm 5\%$ ,  $C1-C4 = 0.1\mu F$ ;  $T_A = T_{MIN}$  TO  $T_{MAX}$ . TYPICAL VALUES ARE AT  $V_{CC} = 3.3V$ ,  $T_A = +25^\circ C$ .

| SYMBOL                                         | PARAMETERS                                         | MIN.   | TYP.   | MAX.            | UNITS | CONDITIONS                                   |
|------------------------------------------------|----------------------------------------------------|--------|--------|-----------------|-------|----------------------------------------------|
| I <sub>OSS</sub>                               | Receiver Output ShortCircuit Current               |        | +/-40  | +/-65           | mA    | 0 < V <sub>O</sub> < V <sub>CC</sub>         |
| I <sub>OZ</sub>                                | Receiver Output Leakage Current                    |        | +/-0.1 | +/-1.5          | μA    | Receivers Disabled                           |
| SINGLE-ENDED RECEIVER INPUTS (RS-232)          |                                                    |        |        |                 |       |                                              |
|                                                | Input Voltage Range                                | -15    |        | +15             | V     |                                              |
|                                                | Input Threshold Low                                | 0.6    | 1.2    |                 | V     | V <sub>CC</sub> = 3.3V                       |
|                                                |                                                    | 0.8    | 1.5    |                 | V     | V <sub>CC</sub> = 5.0V                       |
|                                                | Input Threshold HIGH                               |        | 1.5    | 2.0             | V     | V <sub>CC</sub> = 3.3V                       |
|                                                |                                                    |        | 1.8    | 2.4             | V     | V <sub>CC</sub> = 5.0V                       |
|                                                | Input Hysteresis                                   |        | 0.5    |                 | V     |                                              |
|                                                | Input Resistance                                   | 3      | 5      | 7               | kΩ    |                                              |
| DIFFERENTIAL RECEIVER INPUTS (RS-485 / RS-422) |                                                    |        |        |                 |       |                                              |
| R <sub>IN</sub>                                | Receiver Input Resistance                          | 96     |        |                 | kΩ    | -7V ≤ V <sub>CM</sub> ≤ +12V                 |
| V <sub>TH</sub>                                | Receiver Differential Threshold Voltage            | -200   | -125   | -50             | mV    |                                              |
| ΔV <sub>TH</sub>                               | Receiver Input Hysteresis                          |        | 30     |                 | mV    | V <sub>CM</sub> = 0V                         |
| I <sub>IN</sub>                                | Input Current                                      |        |        | 125             | μA    | V <sub>IN</sub> = 12V                        |
|                                                |                                                    |        |        | -100            | μA    | V <sub>IN</sub> = -7V                        |
| SINGLE-ENDED DRIVER OUTPUTS (RS-232)           |                                                    |        |        |                 |       |                                              |
| V <sub>O</sub>                                 | Output Voltage Swing                               | +/-5.0 | +/-5.4 |                 | V     | Output Loaded with 3kΩ to Gnd                |
|                                                |                                                    |        |        | +/-7.0          | V     | No Load Output                               |
|                                                | Short Circuit Current                              |        |        | +/-60           | mA    | V <sub>O</sub> = 0V                          |
|                                                | Power Off Impedance                                | 300    | 10M    |                 | Ω     | V <sub>CC</sub> = 0V; V <sub>O</sub> = +/-2V |
| DIFFERENTIAL DRIVER OUTPUTS (RS-485 / RS-422)  |                                                    |        |        |                 |       |                                              |
| V <sub>OD</sub>                                | Differential Driver Output (Tx_Out)                | 2      |        | V <sub>CC</sub> | V     | R <sub>L</sub> = 100Ω (RS-422), Figure 2     |
|                                                |                                                    | 1.5    |        | V <sub>CC</sub> | V     | R <sub>L</sub> = 54Ω (RS-485), Figure 2      |
|                                                |                                                    | 1.5    |        | V <sub>CC</sub> | V     | V <sub>CM</sub> = -7V, Figure 3              |
|                                                |                                                    | 1.5    |        | V <sub>CC</sub> | V     | V <sub>CM</sub> = +12V, Figure 3             |
| ΔV <sub>OD</sub>                               | Change In Magnitude of Differential Output Voltage | -0.2   |        | +0.2            | V     | R <sub>L</sub> = 54Ω or 100Ω, Figure 2       |
| V <sub>OC</sub>                                | Driver Common Mode Output Voltage                  |        |        | 3               | V     | R <sub>L</sub> = 54Ω or 100Ω, Figure 2       |
| ΔV <sub>OC</sub>                               | Change In Magnitude of Common Mode Output Voltage  |        |        | 0.2             | V     | R <sub>L</sub> = 54Ω or 100Ω, Figure 2       |
| I <sub>OSD</sub>                               | Driver Output Short Circuit Current                |        |        | +/-250          | mA    | V = +12V to -7V, Figure 4                    |

**UNLESS OTHERWISE NOTED:  $V_{CC} = +3.3V \pm 5\%$  OR  $+5.0V \pm 5\%$ ,  $C_1$ - $C_4 = 0.1\mu F$ ;  $T_A = T_{MIN}$  TO  $T_{MAX}$ . TYPICAL VALUES ARE AT  $V_{CC} = 3.3V$ ,  $T_A = +25^\circ C$ .**

| SYMBOL                                                                                   | PARAMETERS                                                                   | MIN. | TYP. | MAX.      | UNITS      | CONDITIONS                                                                                             |
|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|------|------|-----------|------------|--------------------------------------------------------------------------------------------------------|
| $I_O$                                                                                    | Output Leakage Current                                                       |      |      | $\pm 100$ | $\mu A$    | TXEN = 0V or Shutdown,<br>$V_O = +12V$ to $-7V$                                                        |
| <b>TIMING CHARACTERISTICS</b>                                                            |                                                                              |      |      |           |            |                                                                                                        |
| <b>RS-232 (SP337EB ONLY) DATA RATE = 250kbps, ONE TRANSMITTER SWITCHING</b>              |                                                                              |      |      |           |            |                                                                                                        |
|                                                                                          | Maximum Data Rate                                                            | 250  |      |           | kbps       | $R_L = 3k\Omega$ , $C_L = 2500pF$                                                                      |
| $t_{PHL}, t_{PLH}$                                                                       | Receiver Propagation Delay                                                   |      | 100  |           | ns         | $C_L = 150pF$ , Figures 20 and 21                                                                      |
| $ t_{PHL} - t_{PLH} $                                                                    | Receiver Skew                                                                |      |      | 100       | ns         | $C_L = 150pF$ , Figures 20 and 21                                                                      |
| $t_{PHL}, t_{PLH}$                                                                       | Driver Propagation Delay                                                     |      | 800  |           |            |                                                                                                        |
| $ t_{PHL} - t_{PLH} $                                                                    | Driver Skew                                                                  |      |      | 400       | ns         |                                                                                                        |
|                                                                                          | Receiver Output Enable time                                                  |      |      | 400       | ns         |                                                                                                        |
|                                                                                          | Receiver Output Disable time                                                 |      |      | 400       | ns         |                                                                                                        |
| $t_{THL}, t_{TLH}$                                                                       | Transition-Region Slew Rate from<br>$+3.0V$ to $-3.0V$ or $-3.0V$ to $+3.0V$ | 4    |      | 30        | V/ $\mu s$ | $V_{CC} = 3.3V$ , $R_L = 3k\Omega$ to $7k\Omega$ ,<br>$C_L = 150pF$ to $2500pF$ ,<br>Figures 18 and 19 |
| <b>RS-232 (SP337EU ONLY) DATA RATE = 1Mbps, ONE TRANSMITTER SWITCHING</b>                |                                                                              |      |      |           |            |                                                                                                        |
|                                                                                          | Maximum Data Rate                                                            | 1    |      |           | Mbps       | $R_L = 3k\Omega$ , $C_L = 250pF$                                                                       |
| $t_{PHL}, t_{PLH}$                                                                       | Receiver Propagation Delay                                                   |      | 100  |           | ns         | $C_L = 150pF$ , Figures 20 and 21                                                                      |
| $ t_{PHL} - t_{PLH} $                                                                    | Receiver Skew                                                                |      |      | 100       | ns         | $C_L = 150pF$ , Figures 20 and 21                                                                      |
| $t_{PHL}, t_{PLH}$                                                                       | Driver Propagation Delay                                                     |      | 250  |           |            |                                                                                                        |
| $ t_{PHL} - t_{PLH} $                                                                    | Driver Skew                                                                  |      |      | 150       | ns         |                                                                                                        |
|                                                                                          | Receiver Output Enable time                                                  |      |      | 400       | ns         |                                                                                                        |
|                                                                                          | Receiver Output Disable time                                                 |      |      | 400       | ns         |                                                                                                        |
| $t_{THL}, t_{TLH}$                                                                       | Transition-Region Slew Rate from<br>$+3.0V$ to $-3.0V$ or $-3.0V$ to $+3.0V$ | 50   |      |           | V/ $\mu s$ | $V_{CC} = 3.3V$ , $R_L = 3k\Omega$ ,<br>$C_L = 150pF$ , Figures 18 and 19                              |
| <b>RS-485/RS-422 (SP337EB and SP337EU) DATA RATE = 15Mbps, ONE TRANSMITTER SWITCHING</b> |                                                                              |      |      |           |            |                                                                                                        |
|                                                                                          | Maximum Data Rate                                                            | 15   | 20   |           | Mbps       | $R_{DIFF} = 54\Omega$ , $C_L = 50pF$                                                                   |
| $t_{DPHL}, t_{DPLH}$                                                                     | Differential Output Propagation<br>Delay Time                                |      | 60   | 120       | ns         | Figures 5 and 6                                                                                        |
| $t_R, t_F$                                                                               | Driver Rise and Fall Time                                                    |      | 15   | 25        | ns         | Figures 5 and 6                                                                                        |
| $ t_{DPHL} - t_{DPLH} $                                                                  | Driver Propagation Delay Skew                                                |      |      | 10        | ns         | Figures 5 and 6                                                                                        |
| $t_{DZH}, t_{DZL}$                                                                       | Driver Output Enable Time                                                    |      |      | 400       | ns         | Figures 7, 8, 9 and 10                                                                                 |
| $t_{DHZ}, t_{DLZ}$                                                                       | Driver Output Disable Time                                                   |      |      | 400       | ns         | Figures 7, 8, 9 and 10                                                                                 |
| $t_{PHL}, t_{PLH}$                                                                       | Receiver Propagation Delay                                                   |      | 80   | 150       | ns         | Figures 11 and 12                                                                                      |
| $t_{ZH}$                                                                                 | Receiver Enable to Output High                                               |      | 100  | 200       | ns         | Figures 13 and 14                                                                                      |

UNLESS OTHERWISE NOTED:  $V_{CC} = +3.3V \pm 5\%$  OR  $+5.0V \pm 5\%$ ,  $C1-C4 = 0.1\mu F$ ;  $T_A = T_{MIN}$  TO  $T_{MAX}$ . TYPICAL VALUES ARE AT  $V_{CC} = 3.3V$ ,  $T_A = +25^\circ C$ .

| SYMBOL                                                        | PARAMETERS                                                       | MIN. | TYP.     | MAX. | UNITS | CONDITIONS        |
|---------------------------------------------------------------|------------------------------------------------------------------|------|----------|------|-------|-------------------|
| $t_{ZL}$                                                      | Receiver Enable to Output Low                                    |      | 100      | 200  | ns    | Figures 13 and 15 |
| $t_{HZ}$                                                      | Receiver Output High to Disable                                  |      | 100      | 200  | ns    | Figures 13 and 16 |
| $t_{LZ}$                                                      | Receiver Output Low to Disable                                   |      | 100      | 200  | ns    | Figures 13 and 17 |
| <b>RS-485/RS-422 SHUTDOWN FEATURE APPLIES TO SP337EU ONLY</b> |                                                                  |      |          |      |       |                   |
| $t_{DZV}$                                                     | Shutdown to Driver Output Valid                                  |      | 100      | 400  | ns    |                   |
| $t_{Dshutdn}$                                                 | Driver Time to Shutdown                                          |      | 100      |      | ns    |                   |
| $t_{RZV}$                                                     | Shutdown to Receiver Output Valid                                |      | 400      | 800  | ns    |                   |
| $t_{Rshutdn}$                                                 | Receiver Time to Shutdown                                        |      | 100      |      | ns    |                   |
| <b>ESD PROTECTION</b>                                         |                                                                  |      |          |      |       |                   |
|                                                               | ESD Protection for TX and RI pins 3, 4, 6, 7, 15, 16, 17, 18, 24 |      | $\pm 15$ |      | kV    | Human Body Model  |
|                                                               | All Other Pins                                                   |      | $\pm 2$  |      | kV    | Human Body model  |

FIGURE 2. RS-485 DRIVER DC TEST CIRCUIT

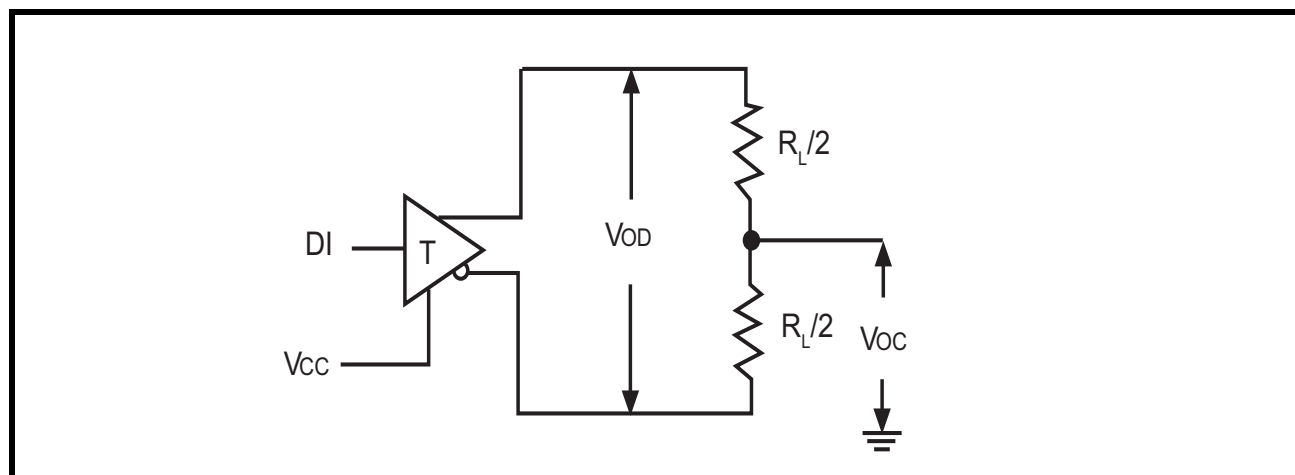
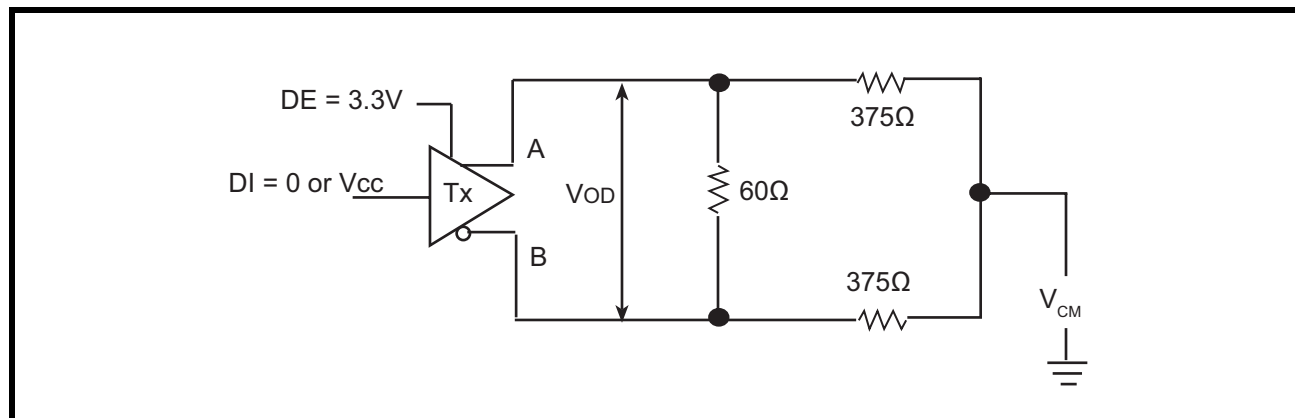
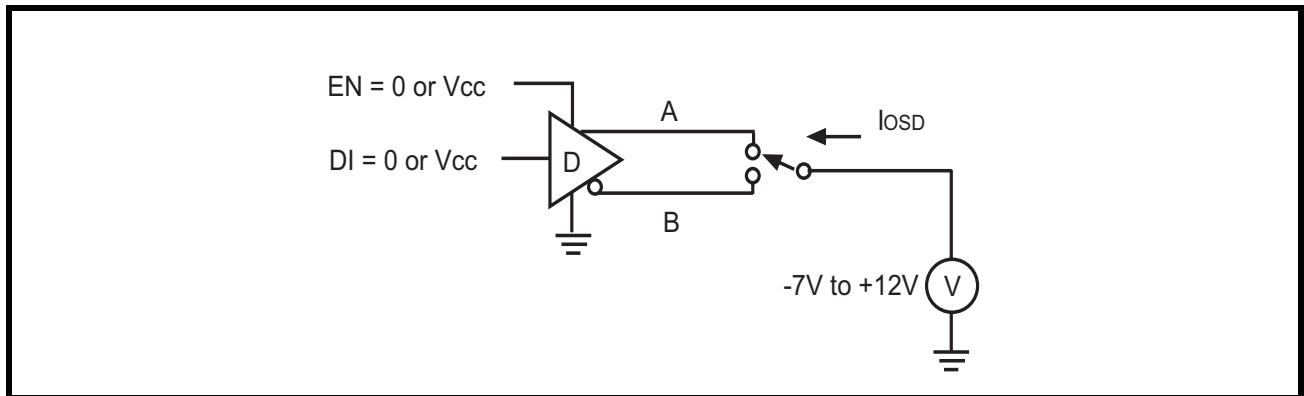


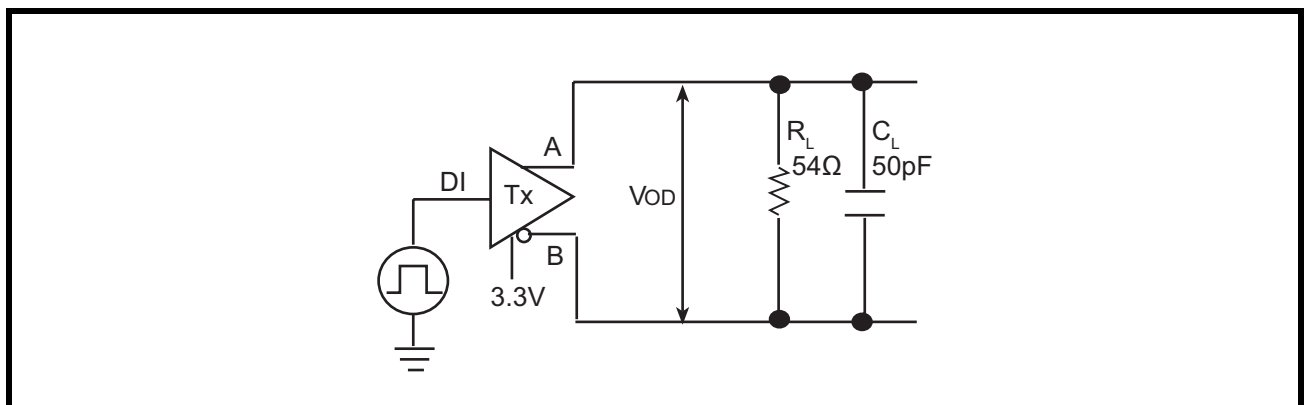
FIGURE 3. RS-485 DRIVER COMMON MODE LOAD TEST



#### FIGURE 4. RS-485 DRIVER OUTPUT SHORT CIRCUIT TEST



**FIGURE 5. RS-485 DRIVER PROPAGATION DELAY TEST CIRCUIT**



### FIGURE 6. RS-485 DRIVER TIMING DIAGRAM

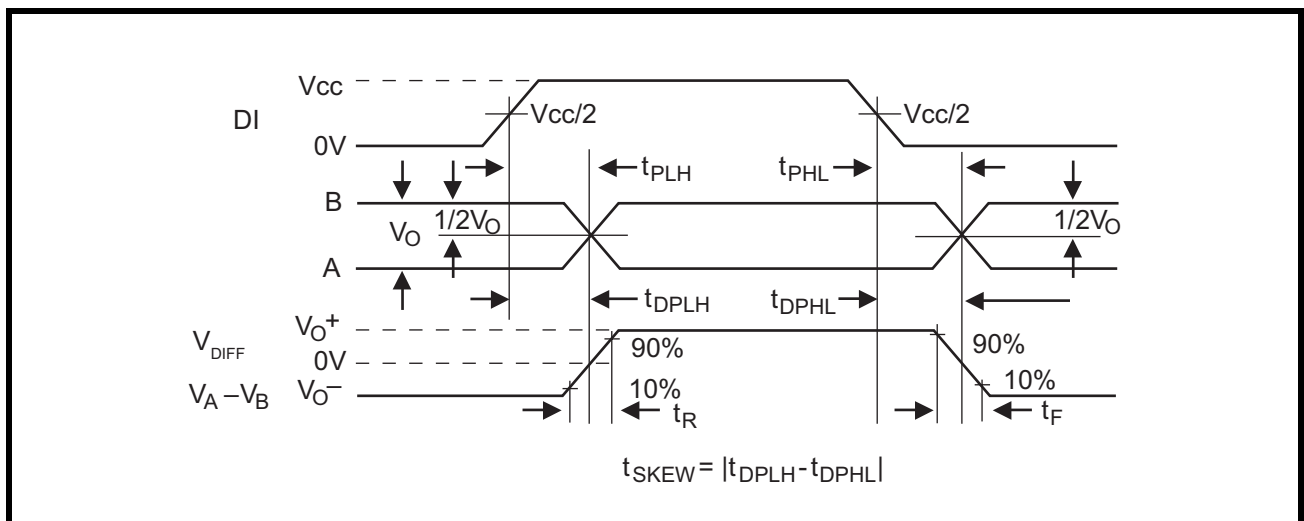


FIGURE 7. RS-485 DRIVER ENABLE AND DISABLE TEST CIRCUIT

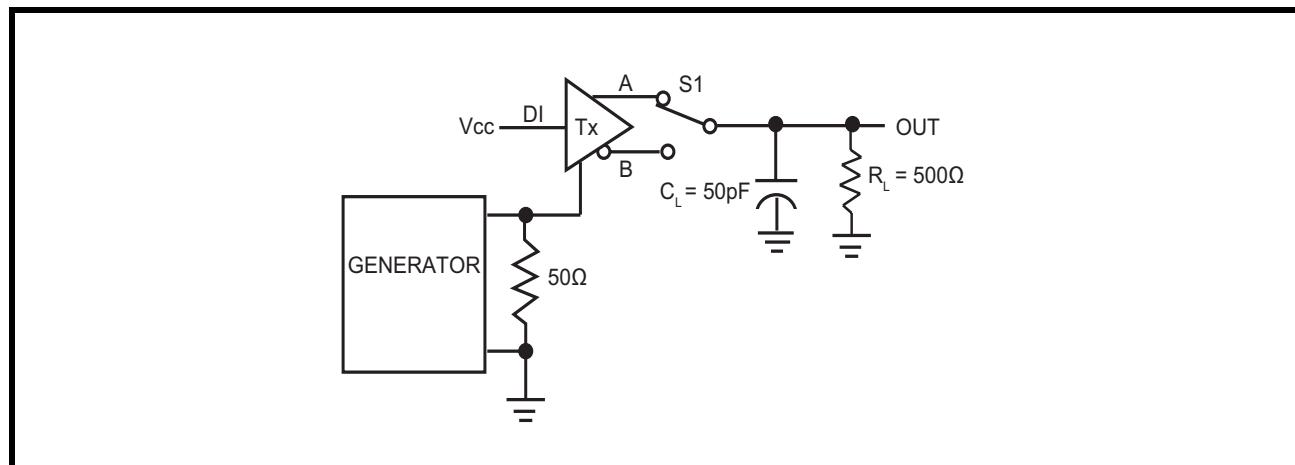


FIGURE 8. RS-485 DRIVER ENABLE AND DISABLE TIMING DIAGRAM

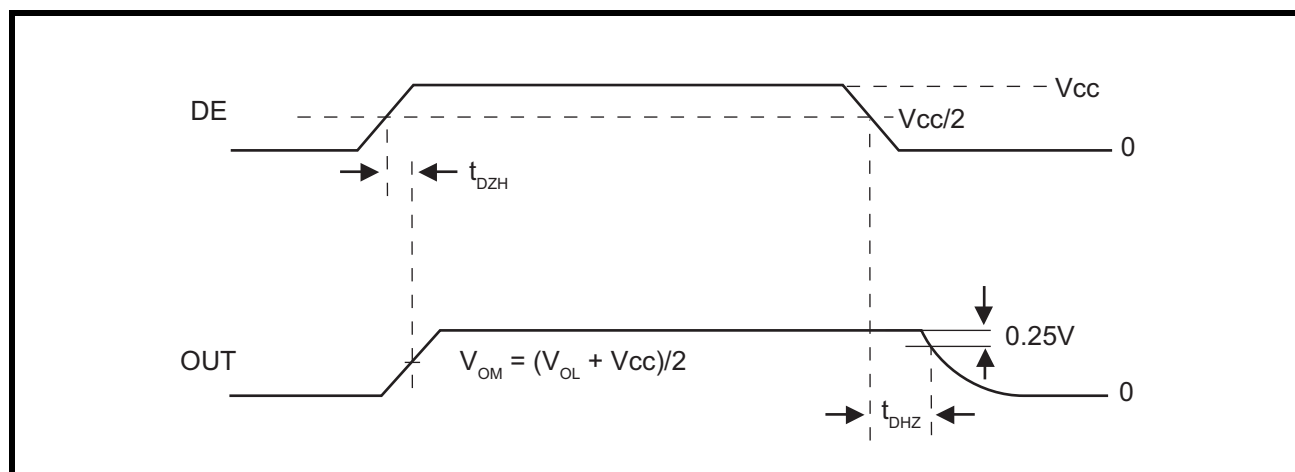


FIGURE 9. RS-485 DRIVER ENABLE AND DISABLE TEST CIRCUIT 2

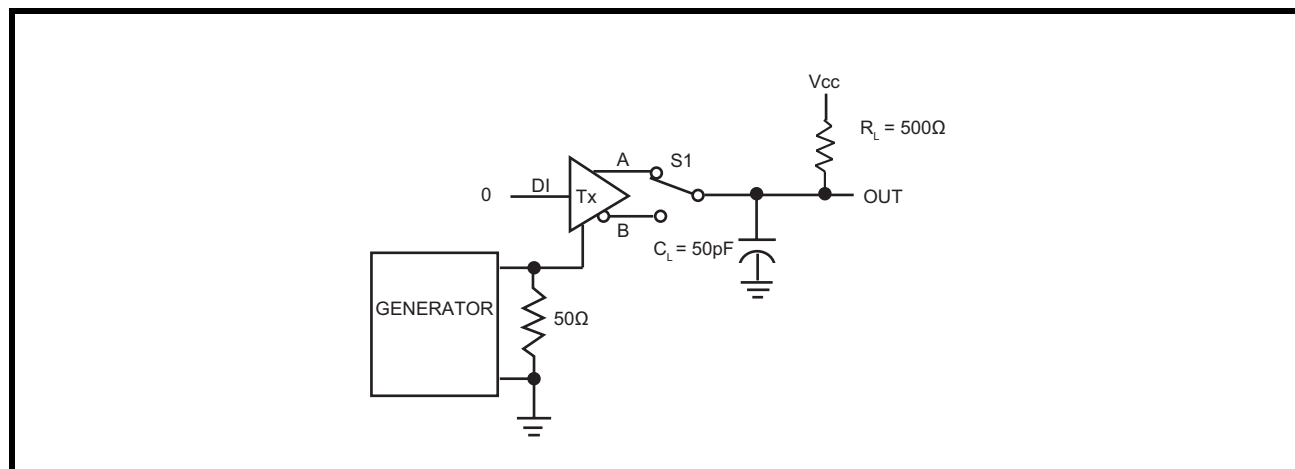


FIGURE 10. RS-485 DRIVER ENABLE AND DISABLE TIMING DIAGRAM 2

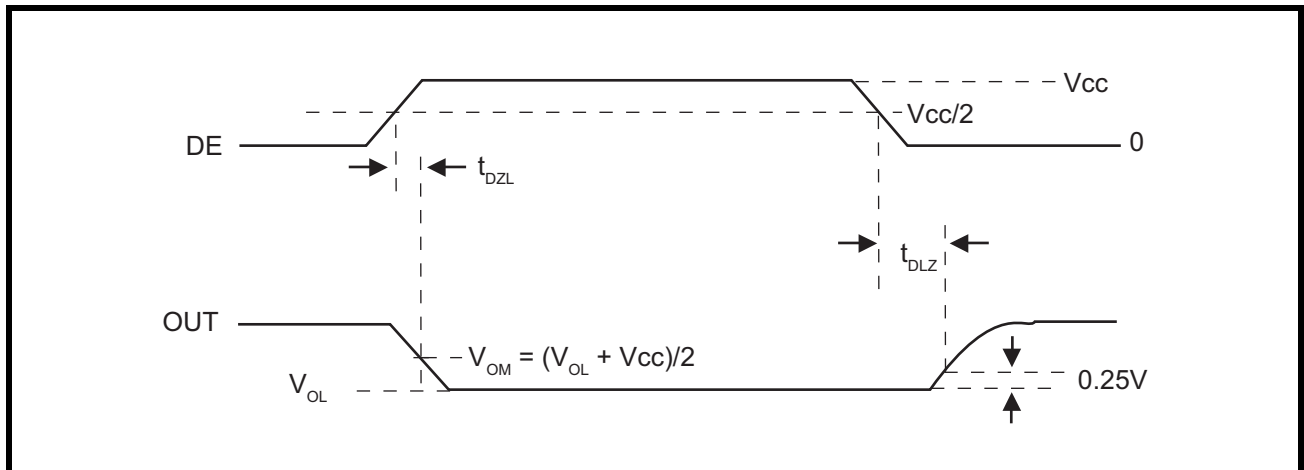


FIGURE 11. RS-485 RECEIVER PROPAGATION DELAY TEST CIRCUIT

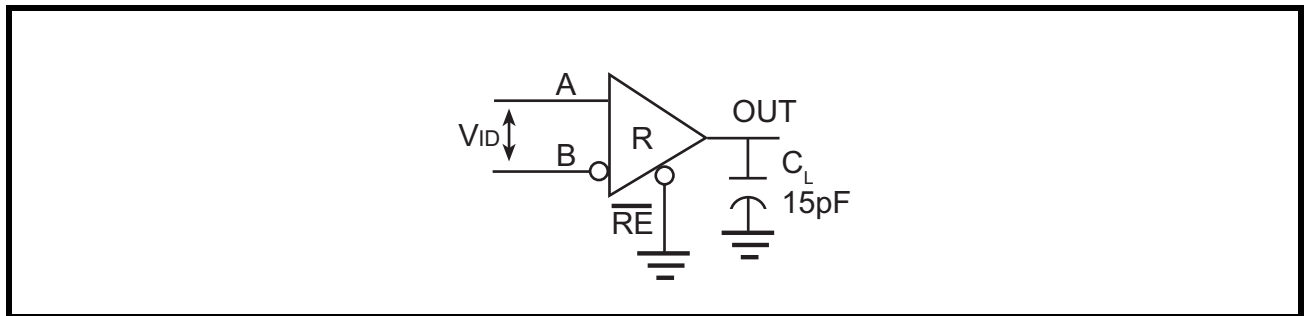


FIGURE 12. RS-485 RECEIVER PROPAGATION DELAY TIMING DIAGRAM

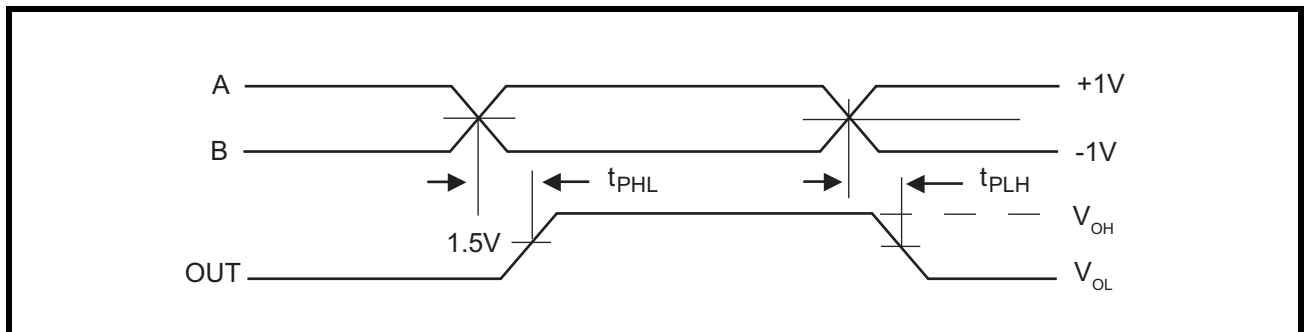


FIGURE 13. RS-485 RECEIVER ENABLE AND DISABLE TIMES TEST CIRCUIT

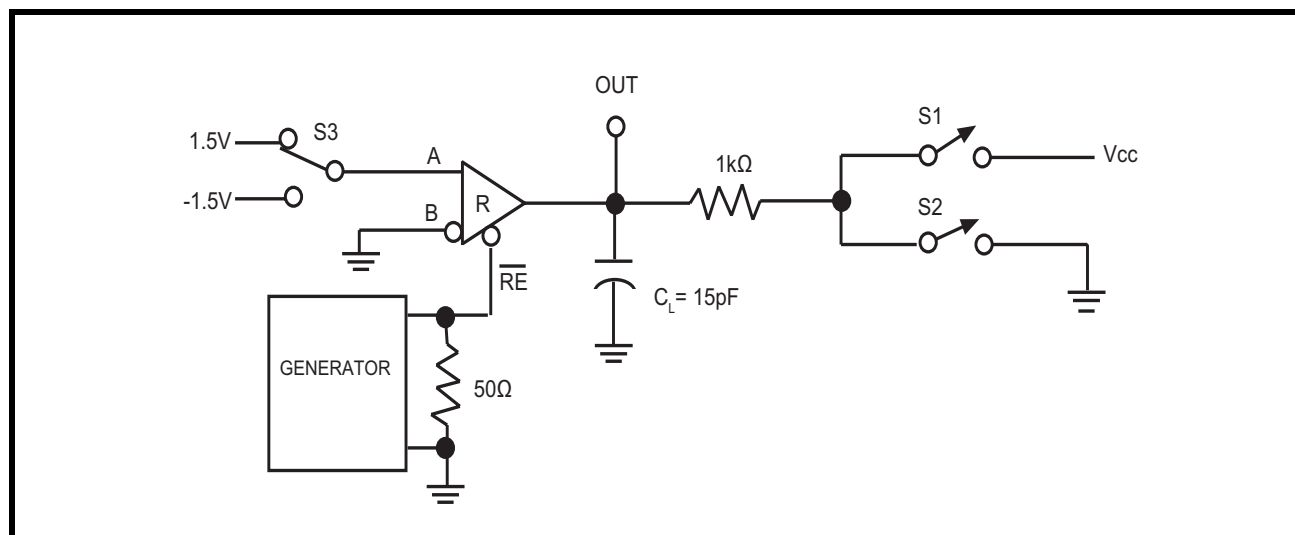


FIGURE 14. RS-485 RECEIVER ENABLE AND DISABLE TIMES TIMING DIAGRAM 1

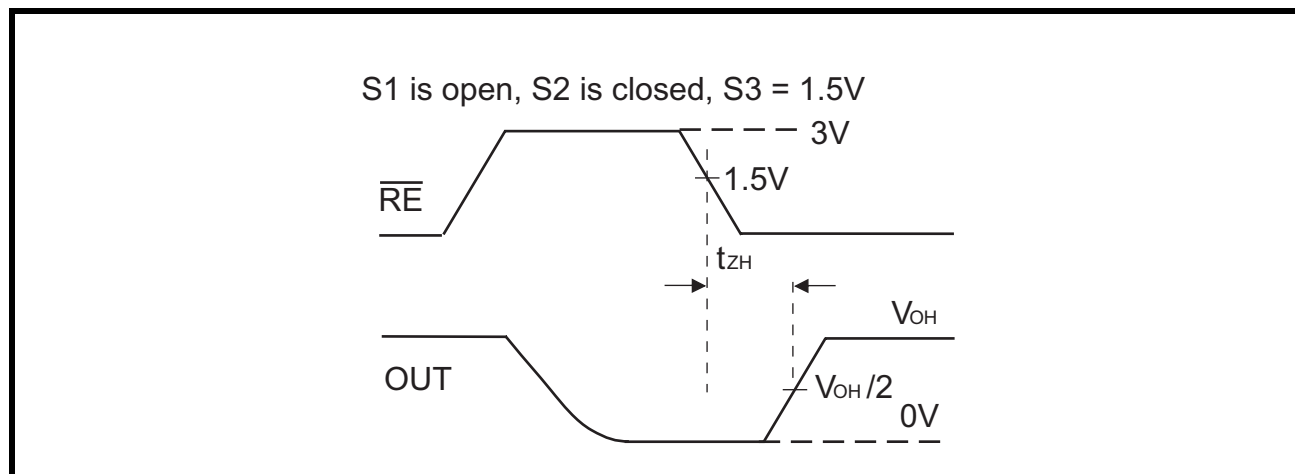
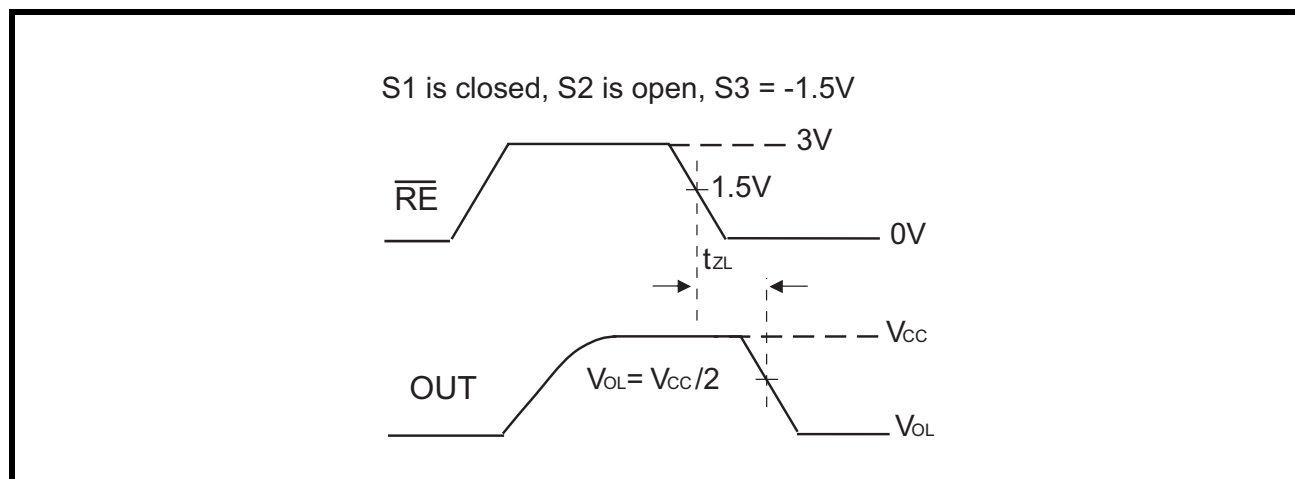


FIGURE 15. RS-485 RECEIVER ENABLE AND DISABLE TIMES TIMING DIAGRAM 2



S1 is open, S2 is closed, S3 = 1.5V

Timing diagram showing the output  $\overline{\text{RE}}$  and  $\text{OUT}$  signals. The input  $\text{OUT}$  is initially at  $0.25\text{V}$ . When  $\overline{\text{RE}}$  transitions from low to high, the output  $\text{OUT}$  transitions from  $0.25\text{V}$  to  $0\text{V}$ . The time interval  $t_{\text{HZ}}$  is marked between the rising edge of  $\overline{\text{RE}}$  and the falling edge of  $\text{OUT}$ . The output  $\text{OUT}$  is labeled with  $V_{\text{OH}}$  and  $0\text{V}$  levels.

S1 is closed, S2 is open, S3 = -1.5V

Timing diagram showing the output  $\overline{RE}$  and  $OUT$  signals. The input  $\overline{RE}$  transitions from 0V to 1.5V and back to 0V. The output  $OUT$  transitions from  $V_{OL}$  to  $V_{CC}$ . The delay time  $t_{LZ}$  is indicated between the rising edge of  $\overline{RE}$  and the rising edge of  $OUT$ . The output  $OUT$  reaches a minimum value of 0.25V during the low state of  $\overline{RE}$ .

The diagram shows a circuit model for a transmission line. On the left, a rectangular block labeled "GENERATOR" is connected to a vertical resistor labeled  $50\Omega$ . The other end of this resistor is connected to a horizontal line that enters a triangular block labeled "Tx", representing the transmission line. The output of the "Tx" block is a horizontal line that passes through a series capacitor labeled  $C_L$ . After the capacitor, there is a shunt connection to ground through a resistor labeled  $R_L$ . The final output of the circuit is labeled "OUT".

FIGURE 19. RS-232 DRIVER OUTPUT SLEW RATE TIMING DIAGRAM

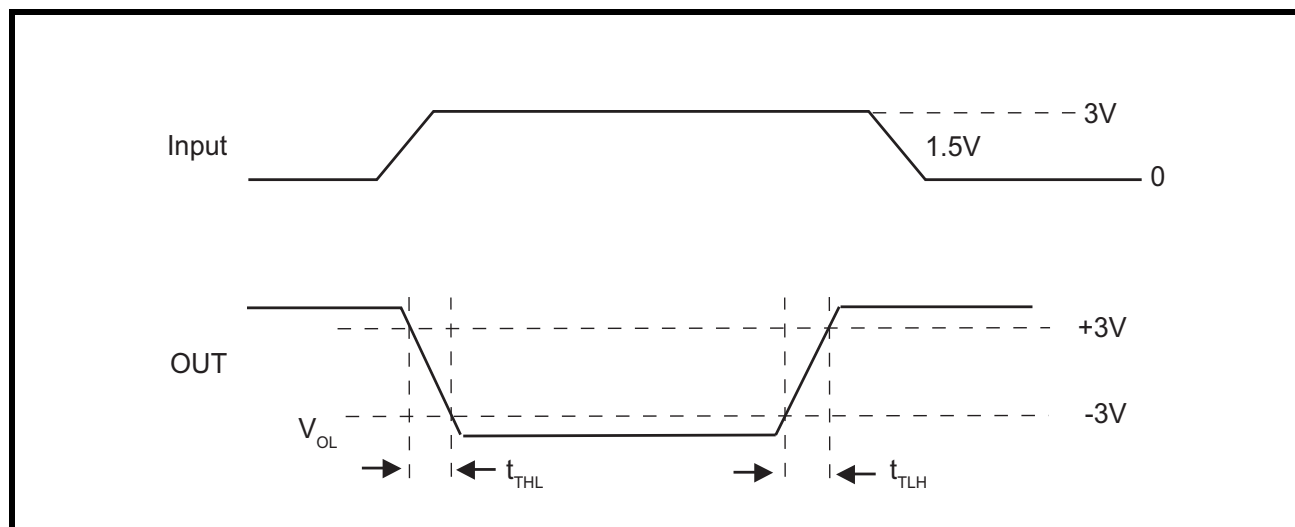


FIGURE 20. RS-232 RECEIVER PROPAGATION DELAY TEST CIRCUIT

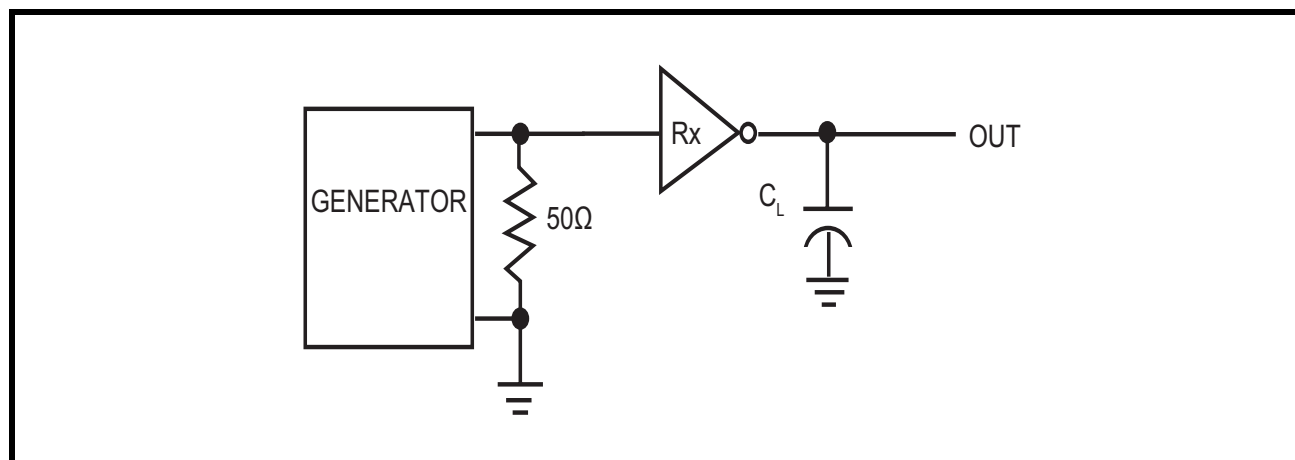
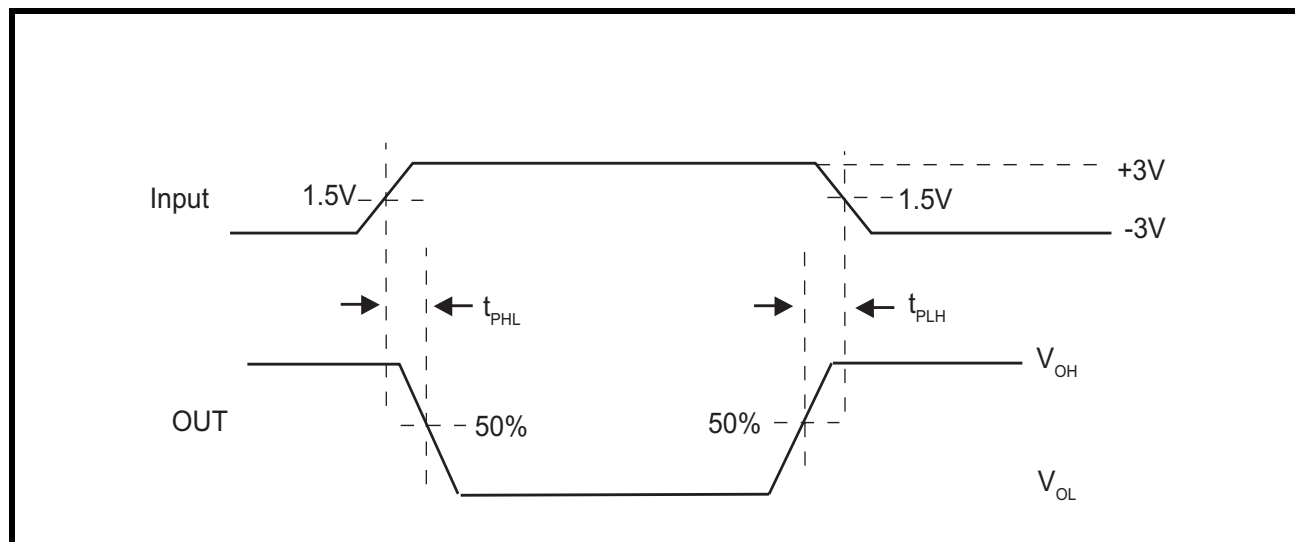


FIGURE 21. RS-232 RECEIVER PROPAGATION DELAY TIMING DIAGRAM



**SP337E Mode Configuration tables**
**TABLE 1: SP337EB**

| RS232/RS485 | TXEN    | R $\overline$ XEN | Operation                 |       | Charge Pump | Driver and Receiver                                                           |
|-------------|---------|-------------------|---------------------------|-------|-------------|-------------------------------------------------------------------------------|
| Low         | Ignored | Low               | RS-232                    | 3T/5R | ON          | Receivers Enabled                                                             |
| Low         | Ignored | High              | RS-232                    | 3T/5R | ON          | Receivers Disabled<br>(High-Z Output)                                         |
| High        | Low     | Low               | RS-485/422<br>Full-Duplex | 2T/2R | ON          | Drivers Disabled<br>(High-Z Output);<br>Receivers Enabled                     |
| High        | High    | High              | RS-485/422<br>Full-Duplex | 2T/2R | ON          | Drivers Enabled;<br>Receivers Disabled<br>(High-Z Output)                     |
| High        | Low     | High              | RS-485/422<br>Full-Duplex | 2T/2R | ON          | Drivers Disabled<br>(High Z output);<br>Receivers Disabled<br>(High Z output) |
| High        | High    | Low               | RS-485/422<br>Full-Duplex | 2T/2R | ON          | Drivers Enabled;<br>Receivers Enabled                                         |

**TABLE 2: SP337EU**

| RS232/RS485 | TXEN    | R $\overline$ XEN | Operation                 |       | Charge Pump       | Driver and Receiver                                                           |
|-------------|---------|-------------------|---------------------------|-------|-------------------|-------------------------------------------------------------------------------|
| Low         | Ignored | Low               | RS-232                    | 3T/5R | ON                | Receivers Enabled                                                             |
| Low         | Ignored | High              | RS-232                    | 3T/5R | ON                | Receivers Disabled<br>(High-Z Output)                                         |
| High        | Low     | Low               | RS-485/422<br>Full-Duplex | 2T/2R | ON                | Drivers Disabled<br>(High-Z Output);<br>Receivers Enabled                     |
| High        | High    | High              | RS-485/422<br>Full-Duplex | 2T/2R | ON                | Drivers Enabled;<br>Receivers Disabled<br>(High-Z Output)                     |
| High        | Low     | High              | RS-485/422<br>Full-Duplex | 2T/2R | OFF<br>(Shutdown) | Drivers Disabled<br>(High Z output);<br>Receivers Disabled<br>(High Z output) |
| High        | High    | Low               | RS-485/422<br>Full-Duplex | 2T/2R | ON                | Drivers Enabled;<br>Receivers Enabled                                         |

FIGURE 22. 28 PIN SOICW PACKAGE OUTLINE DRAWING

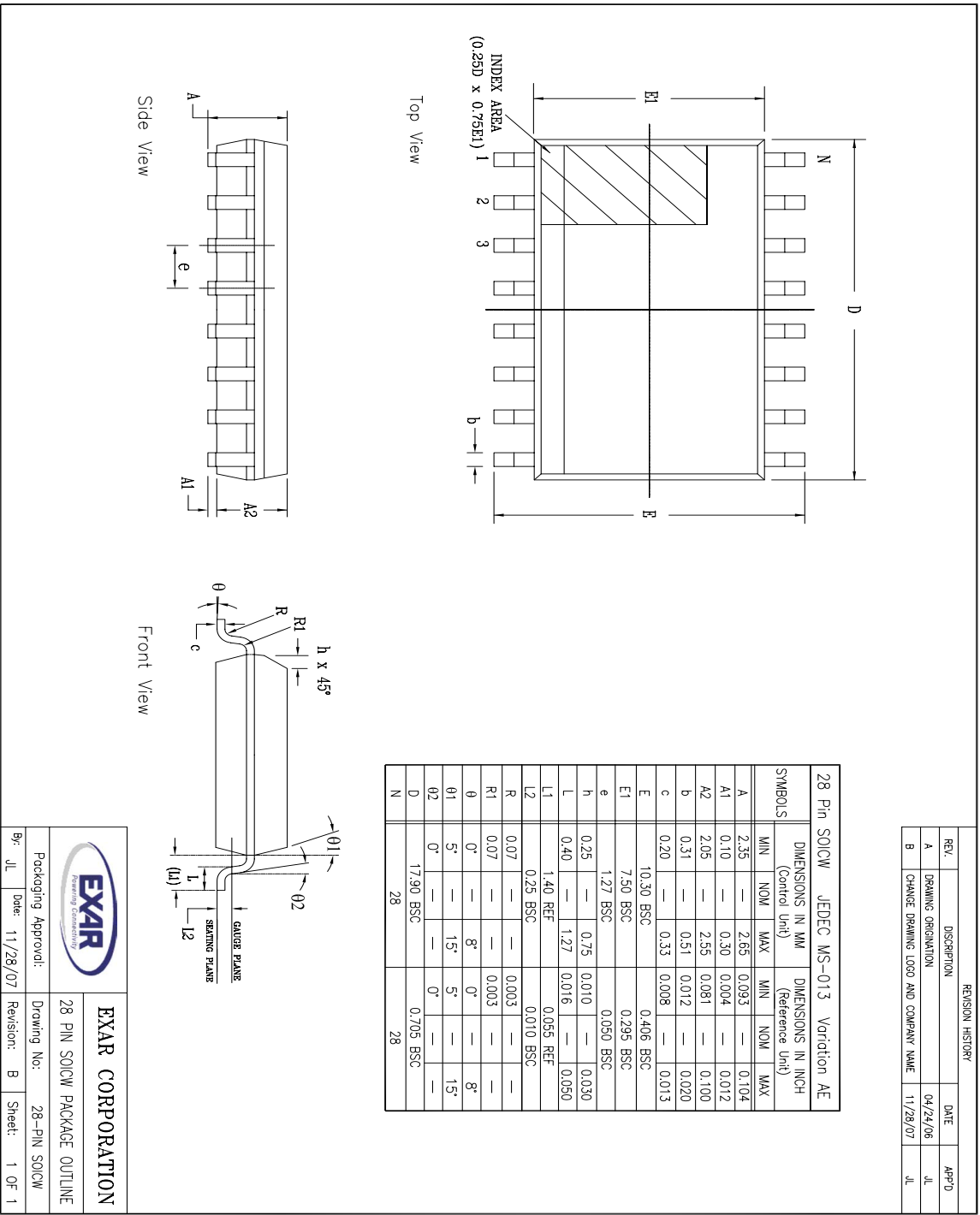
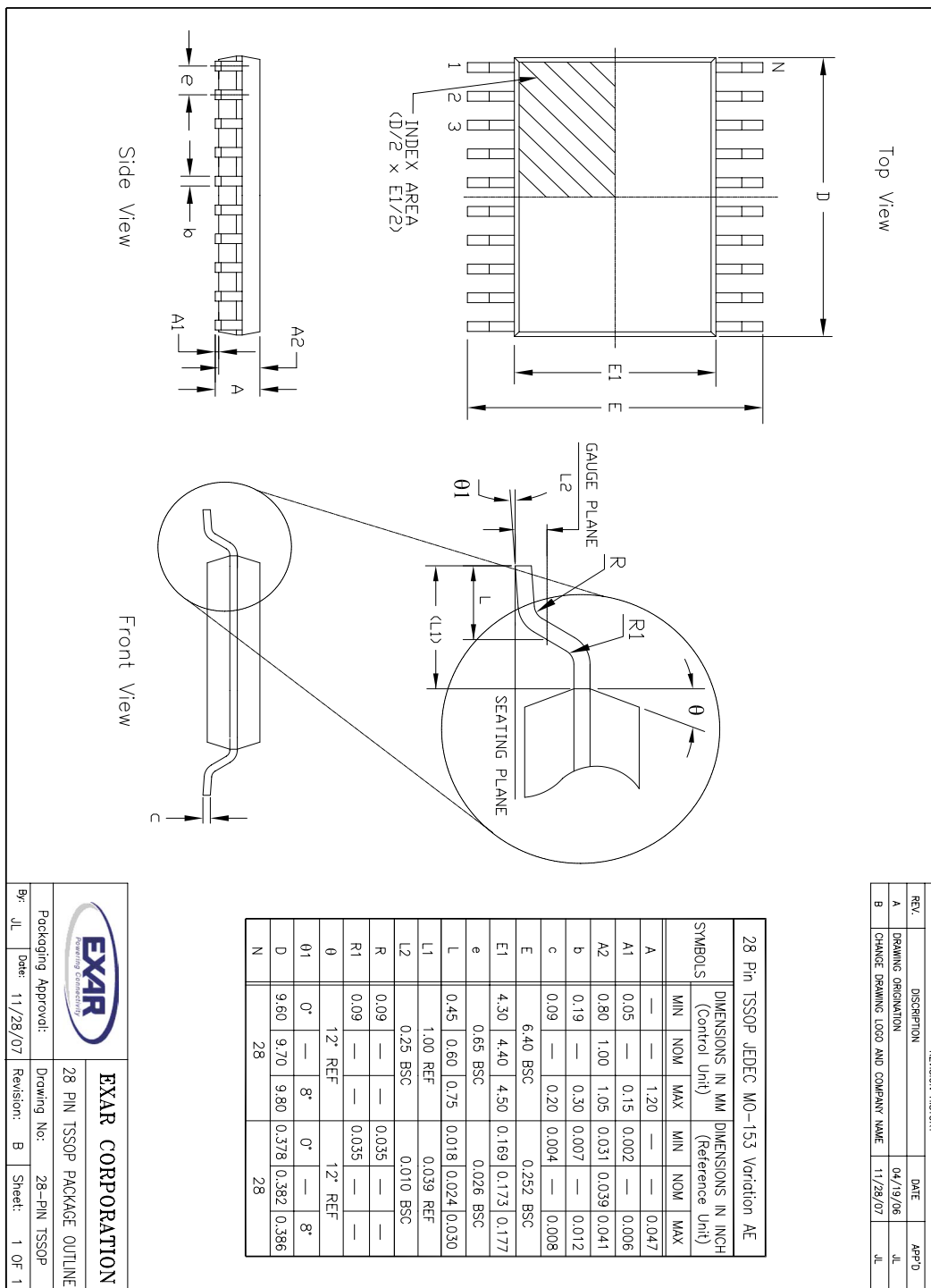


FIGURE 23. 28 PIN TSSOP PACKAGE OUTLINE DRAWING



**SP337E**



**3.3V TO 5V RS-232/RS-485/RS-422 MULTIPROTOCOL TRANSCEIVER**

**REV. 1.0.1**

**REVISION HISTORY**

| DATE          | REVISION | DESCRIPTION             |
|---------------|----------|-------------------------|
| December 2010 | 1.0.0    | Production Release.     |
| December 2010 | 1.0.1    | Update ESD information. |

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