

GENERAL DESCRIPTION

The **SP337E** is a dual mode serial transceiver containing both RS-232 and RS-485/422 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 **SP337E** is pin compatible to MaxLinear'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 **MaxLinear**-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 μ 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 mode, each driver may be individually enabled or put into tri-state, simplifying use on shared buses or for bidirectional communication. The RS-485/422 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 Ω pull-down to ground. in RS-485 mode, receivers will default to output logic 1 if inputs are floating, shorted, or open but terminated.

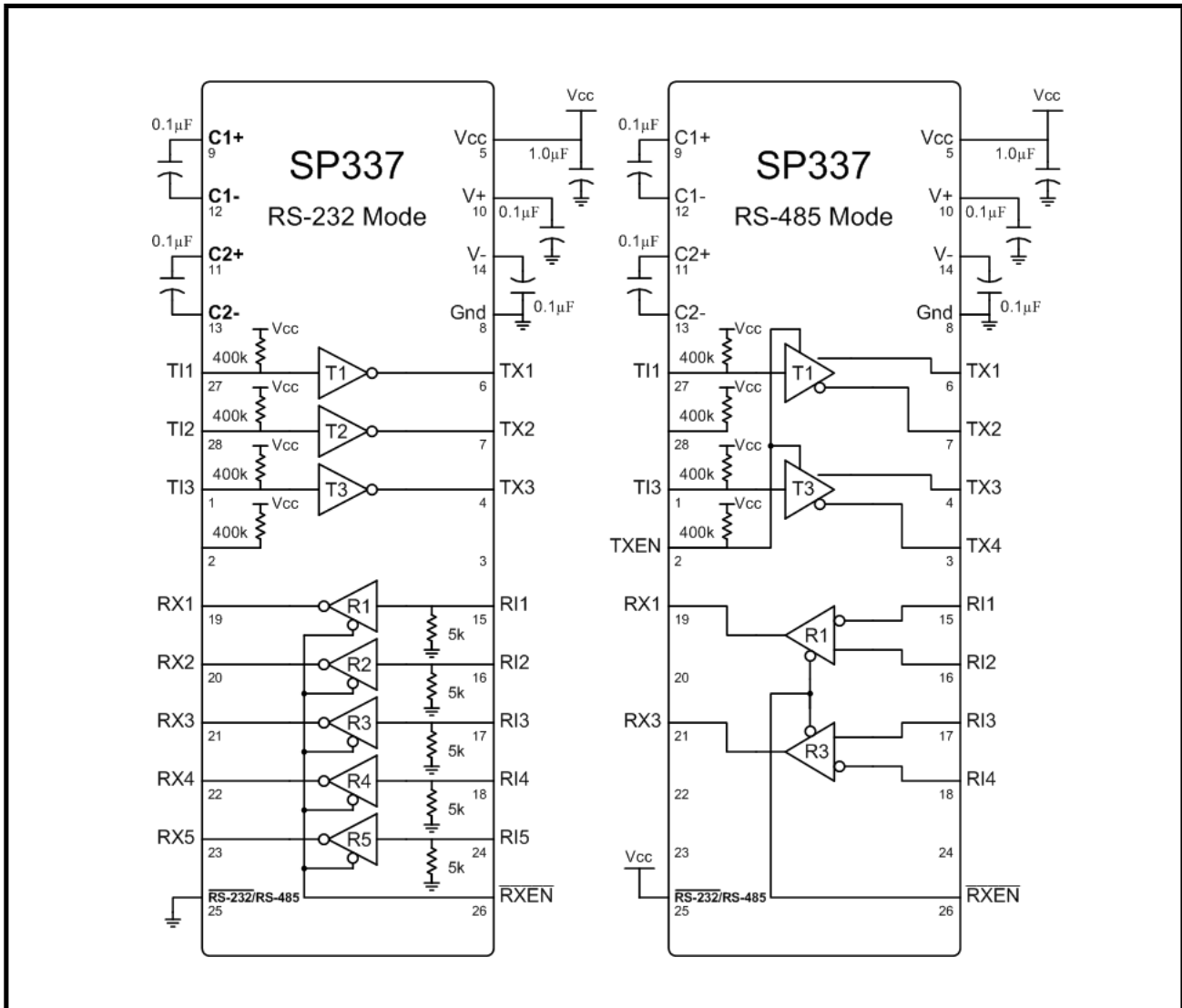
All driver outputs and receiver inputs are protected against ESD strikes up to $\pm 15,000$ volts.

FEATURES

- 3.3V to 5V Single Supply Operation
- Robust ± 15 kV ESD Protection
 - Human Body Model
- Max Data Rate of 15Mbps in RS-485 mode 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
- 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

3.3V TO 5V RS-232/RS-485/RS-422 MULTIPROTOCOL TRANSCEIVER
FIGURE 1. TYPICAL RS-232 AND RS-485 APPLICATION CIRCUITS

ORDERING INFORMATION

| PART NUMBER | OPERATING TEMPERATURE RANGE | PACKAGE | PACKAGING METHOD | LEAD-FREE |
|----------------------|---|--------------|------------------|-----------|
| SP337EBEY-L | -40°C to +85°C | 28-pin TSSOP | Tube | Yes |
| SP337EBEY-L/TR | -40°C to +85°C | 28-pin TSSOP | Tape and Reel | Yes |
| SP337EUEY-L | -40°C to +85°C | 28-pin TSSOP | Tube | Yes |
| SP337EUEY-L/TR | -40°C to +85°C | 28-pin TSSOP | Tape and Reel | Yes |
| XR21B1420IL28-0A-EVB | The XR21B1420 Evaluation Board includes the SP339E transceiver. | | | |

NOTE: For the most up-to-date ordering information and additional information on environmental rating, go to www.maxlinear.com/SP337.

PIN DESCRIPTIONS

Pin Assignments

| PIN # | PIN NAME | TYPE | DESCRIPTION | |
|-------|-------------|--------|---|------------------------------------|
| | | | RS-232 | RS-485/RS-422 |
| 1 | T3 | 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 | T11 | Input | T1 Driver Input | T1 Driver Input |
| | | | This pin has a 400k pull-up to V _{CC} in both RS-232 and RS-485 modes. The pull-up is disabled in the SP337EU shutdown mode. | |
| 28 | T12 | Input | T2 Driver Input | X* |
| | | | This pin has a 400k pull-up to V _{CC} in both RS-232 and RS-485 modes. 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 V_{CC} or go below ground. Some of these pins have a pull-up to V_{CC} which remains active in both RS-232 and RS-485 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 TSSOP (derate 12mW/°C above +70°C) | 657mW |
| ESD Ratings | |
| HBM - Human Body Model (TX and RI Pins 3, 4, 6, 7, 15, 16, 17, 18, 24) | ±15kV |
| HBM - Human Body Model (all other pins) | ± 2kV |
| IEC 61000-4-2 Airgap Discharge (TX & RI Pins) | ±15kV |
| IEC 61000-4-2 Contact Discharge (TX & RI Pins) | ± 8kV |

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 = 0.1µF; $T_A = T_{MIN}$ TO T_{MAX} .

TYPICAL VALUES ARE AT $V_{CC} = 3.3V$, $T_A = +25^\circ C$.

| SYMBOL | PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|--|--|------|------|------|-------|---|
| DC CHARACTERISTICS | | | | | | |
| 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 (SP337EU only) | | 1.0 | 10.0 | µA | TXEN = 0V, RXEN = V_{CC} (SP337EU only) |
| TRANSMITTER and LOGIC INPUT PINS: Pins 1, 2, 25, 26, 27, 28 | | | | | | |
| 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 | µA | Input High ($V_{IN} = V_{CC}$) |
| I_{PU} | Logic Input Pull-up Current | | | 15.0 | µA | Input Low ($V_{IN} = 0V$) |
| V_{HYS} | Logic Input Hysteresis | | 0.5 | | V | |

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

 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 |
|--|--|--------------|-----------|-----------|-----------|--|
| RS-232 and RS-485/422 RECEIVER OUTPUTS: Pins 19, 20, 21, 22, 23 | | | | | | |
| V_{OH} | Receiver Output Voltage HIGH | $V_{CC}-0.6$ | | | V | $I_{OUT} = 1.0mA$ |
| V_{OL} | Receiver Output Voltage LOW | | | 0.4 | V | $I_{OUT} = -3.2mA$ |
| I_{OSS} | Receiver Output ShortCircuit Current | | ± 40 | ± 65 | mA | $0 < V_O < V_{CC}$ |
| I_{OZ} | 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 | $V_{CC} = 3.3V$ |
| | | 0.8 | 1.5 | | V | $V_{CC} = 5.0V$ |
| | Input Threshold HIGH | | 1.5 | 2.0 | V | $V_{CC} = 3.3V$ |
| | | | 1.8 | 2.4 | V | $V_{CC} = 5.0V$ |
| | Input Hysteresis | | 0.5 | | V | |
| | Input Resistance | 3 | 5 | 7 | $k\Omega$ | |
| DIFFERENTIAL RECEIVER INPUTS (RS-485 / RS-422) | | | | | | |
| R_{IN} | Receiver Input Resistance | 96 | | | $k\Omega$ | $-7V \leq V_{CM} \leq +12V$ |
| V_{TH} | Receiver Differential Threshold | -200 | -125 | -50 | mV | |
| ΔV_{TH} | Receiver Input Hysteresis | | 30 | | mV | $V_{CM} = 0V$ |
| I_{IN} | Input Current | | | 125 | μA | $V_{IN} = 12V$ |
| | | | | -100 | μA | $V_{IN} = -7V$ |
| SINGLE-ENDED DRIVER OUTPUTS (RS-232) | | | | | | |
| V_O | Output Voltage Swing | ± 5.0 | ± 5.4 | | V | Output Loaded with $3k\Omega$ to Gnd |
| | | | | ± 7.0 | V | No Load Output |
| | Short Circuit Current | | | ± 60 | mA | $V_O = 0V$ |
| | Power Off Impedance | 300 | 10M | | Ω | $V_{CC} = 0V$; $V_O = \pm 2V$ |
| DIFFERENTIAL DRIVER OUTPUTS (RS-485 / RS-422) | | | | | | |
| V_{OD} | Differential Driver Output (Tx_Out) | 2 | | V_{CC} | V | $R_L = 100\Omega$ (RS-422), Figure 2 |
| | | 1.5 | | V_{CC} | V | $R_L = 54\Omega$ (RS-485), Figure 2 |
| | | 1.5 | | V_{CC} | V | $V_{CM} = -7V$, Figure 3 |
| | | 1.5 | | V_{CC} | V | $V_{CM} = +12V$, Figure 3 |
| ΔV_{OD} | Change In Magnitude of Differential Output Voltage | -0.2 | | +0.2 | V | $R_L = 54\Omega$ or 100Ω , Figure 2 |
| V_{OC} | Driver CommonMode Output Voltage | | | 3 | V | $R_L = 54\Omega$ or 100Ω , Figure 2 |
| ΔV_{OC} | Change In Magnitude of Common Mode Output Voltage | | | 0.2 | V | $R_L = 54\Omega$ or 100Ω , Figure 2 |

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

 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_{OSD} | Driver Output Short Circuit Current | | | ± 250 | mA | $V = +12V$ to $-7V$, Figure 4 |
| I_O | Output Leakage Current | | | ± 100 | μA | TXEN = 0V or Shutdown, $V_O = +12V$ to $-7V$, $V_{CC} = 0V$ or $5.25V$ |
| TIMING CHARACTERISTICS | | | | | | |
| RS-232 (SP337EB ONLY) DATA RATE = 250kbps, ONE TRANSMITTER SWITCHING | | | | | | |
| | Maximum Data Rate | 250 | | | kbps | $R_L = 3k\Omega$, $C_L = 1000pF$ |
| 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 | | ns | |
| $ 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 $+3.0V$ to $-3.0V$ or $-3.0V$ to $+3.0V$ | 4 | | 30 | V/ μs | $V_{CC} = 3.3V$, $R_L = 3k\Omega$ to $7k\Omega$, $C_L = 150pF$ to $2500pF$, Figures 18 and 19 |
| RS-232 (SP337EU ONLY) DATA RATE = 1Mbps, ONE TRANSMITTER SWITCHING | | | | | | |
| | 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 | | ns | |
| $ 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 $+3.0V$ to $-3.0V$ or $-3.0V$ to $+3.0V$ | 50 | | | V/ μs | $V_{CC} = 3.3V$, $R_L = 3k\Omega$, $C_L = 150pF$, Figures 18 and 19 |
| RS-485/RS-422 (SP337EB and SP337EU) DATA RATE = 15Mbps, ONE TRANSMITTER SWITCHING | | | | | | |
| | Maximum Data Rate | 15 | 20 | | Mbps | $R_{DIFF} = 54\Omega$, $C_L = 50pF$ |
| t_{DPHL}, t_{DPLH} | Differential Output Propagation 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 |

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

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_{ZH} | Receiver Enable to Output High | | 100 | 200 | ns | Figures 13 and 14 |
| 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 |
| RS-485/RS-422 SHUTDOWN FEATURE APPLIES TO SP337EU ONLY | | | | | | |
| t_{DZZV} | Shutdown n to Driver Output Valid | | | 30 | μs | |
| $t_{Dshutdw_n}$ | Driver Time to Shutdown n | | 100 | | ns | |
| t_{RZZV} | Shutdown n to Receiver Output Valid | | | 30 | μs | |
| $t_{Rshutdw_n}$ | Receiver Time to Shutdown n | | 100 | | ns | |

FIGURE 2. RS-485 DRIVER DC TEST CIRCUIT

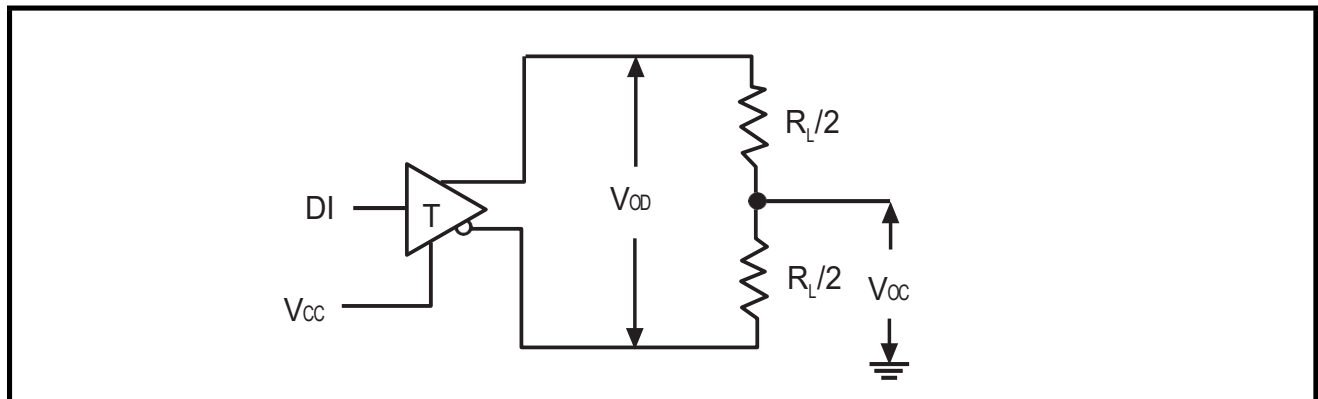


FIGURE 3. RS-485 DRIVER COMMON MODE LOAD TEST

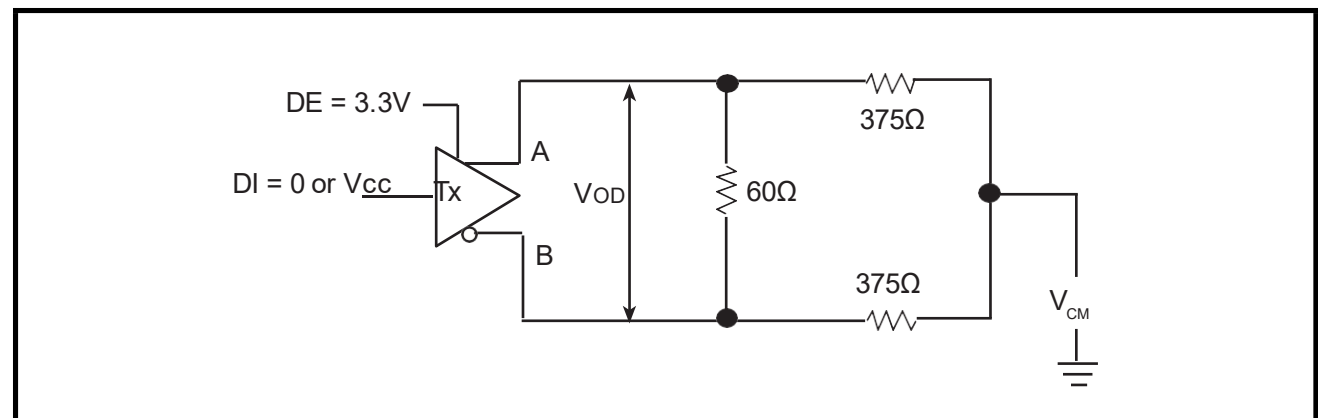


FIGURE 4. RS-485 DRIVER OUTPUT SHORT CIRCUIT TEST

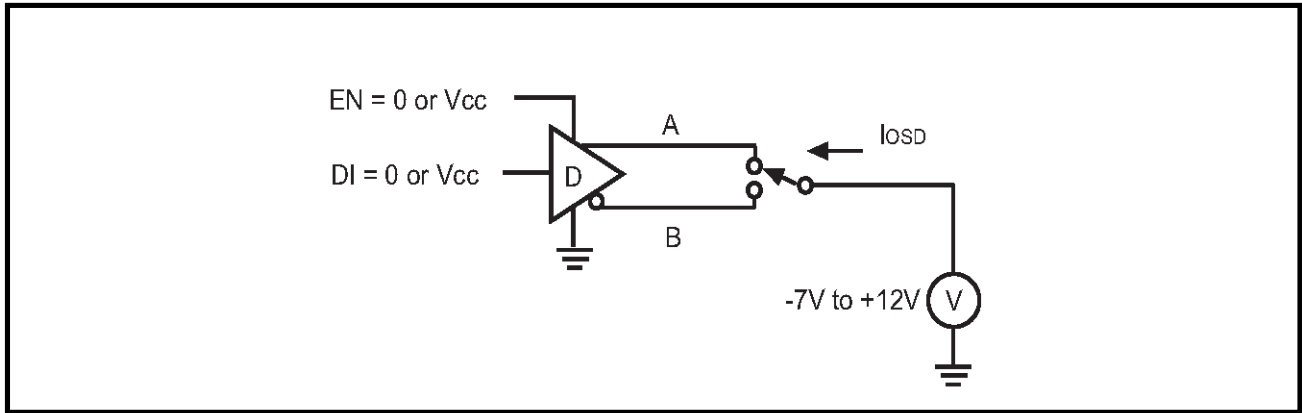


FIGURE 5. RS-485 DRIVER PROPAGATION DELAY TEST CIRCUIT

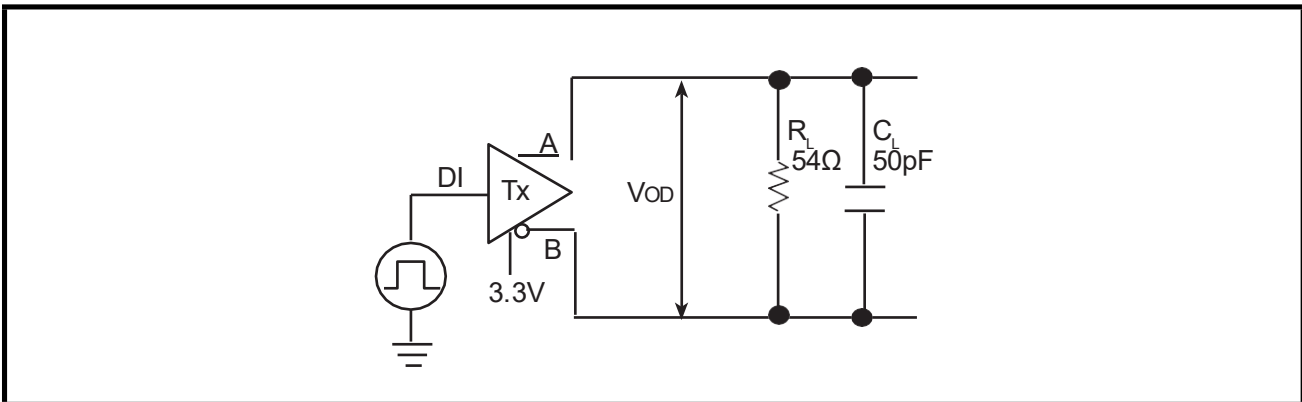


FIGURE 6. RS-485 DRIVER TIMING DIAGRAM

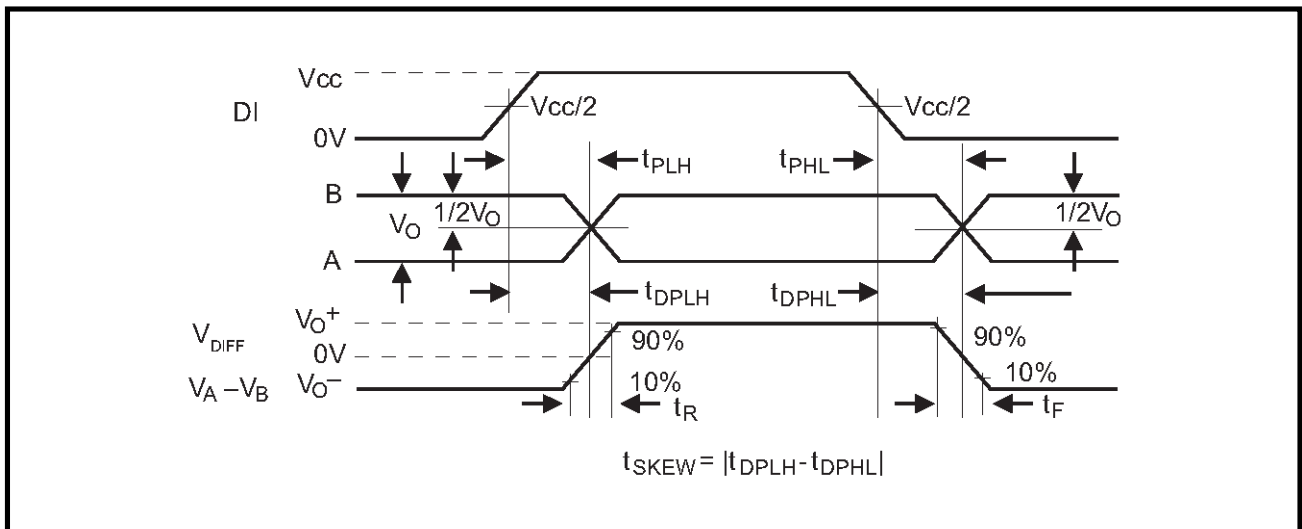


FIGURE 7. RS-485 DRIVER ENABLE AND DISABLE TEST CIRCUIT

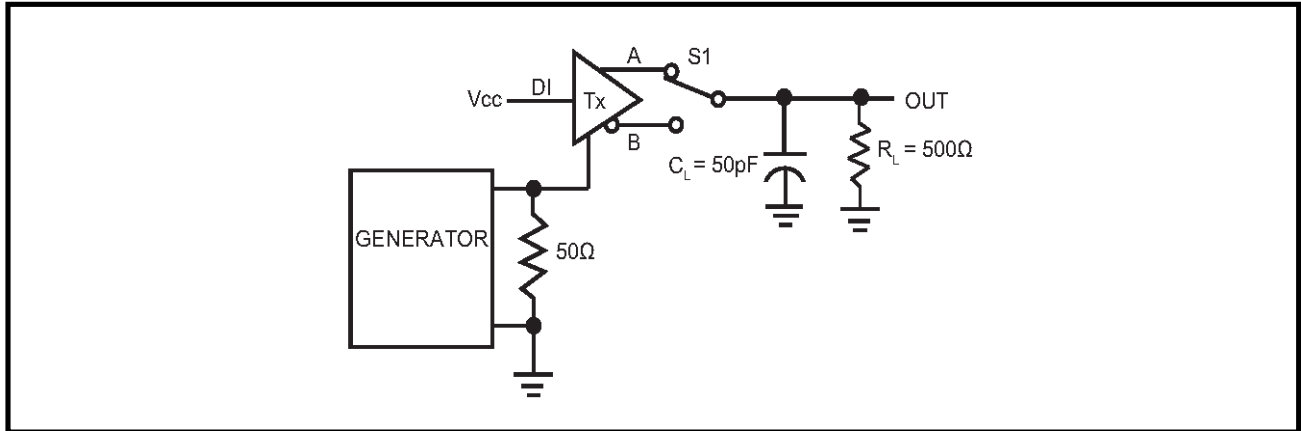


FIGURE 8. RS-485 DRIVER ENABLE AND DISABLE TIMING DIAGRAM

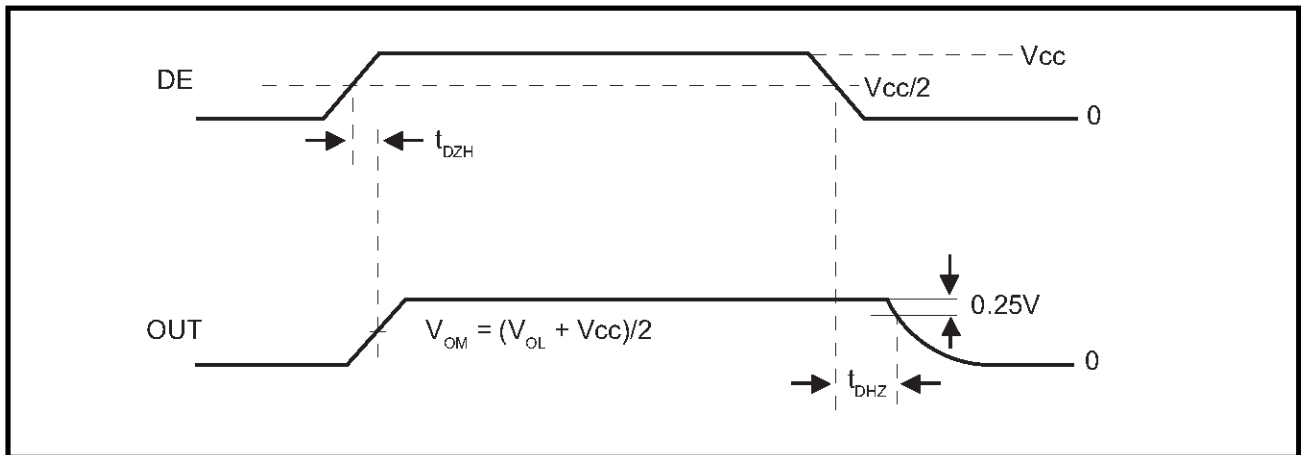


FIGURE 9. RS-485 DRIVER ENABLE AND DISABLE TEST CIRCUIT 2

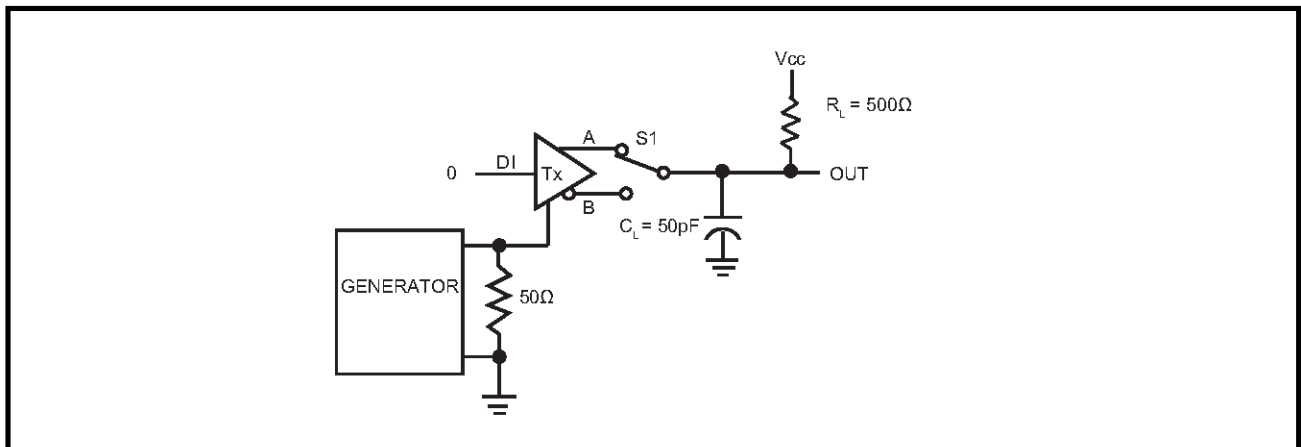


FIGURE 10. RS-485 DRIVER ENABLE AND DISABLE TIMING DIAGRAM 2

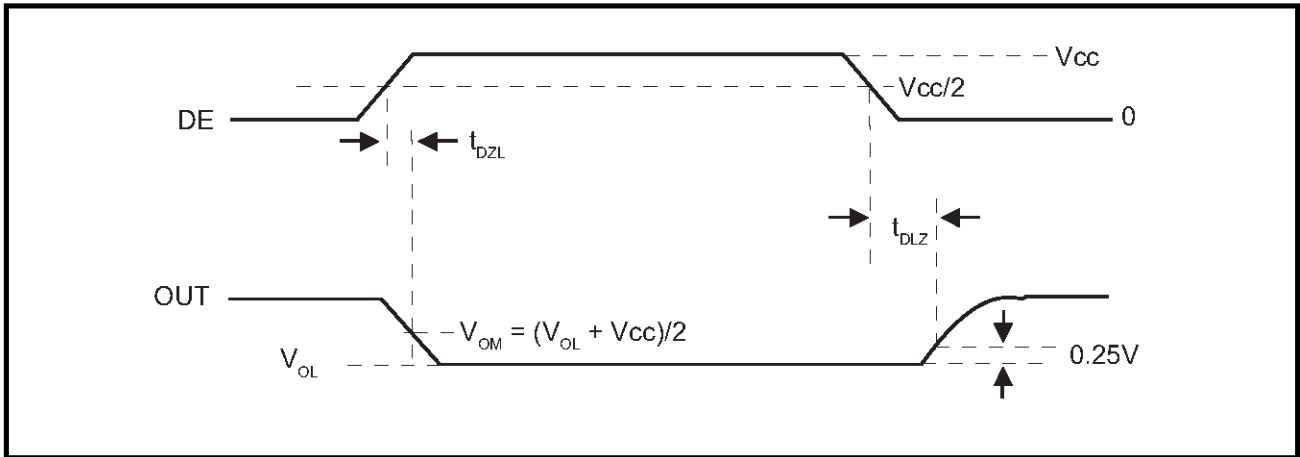


FIGURE 11. RS-485 RECEIVER PROPAGATION DELAY TEST CIRCUIT

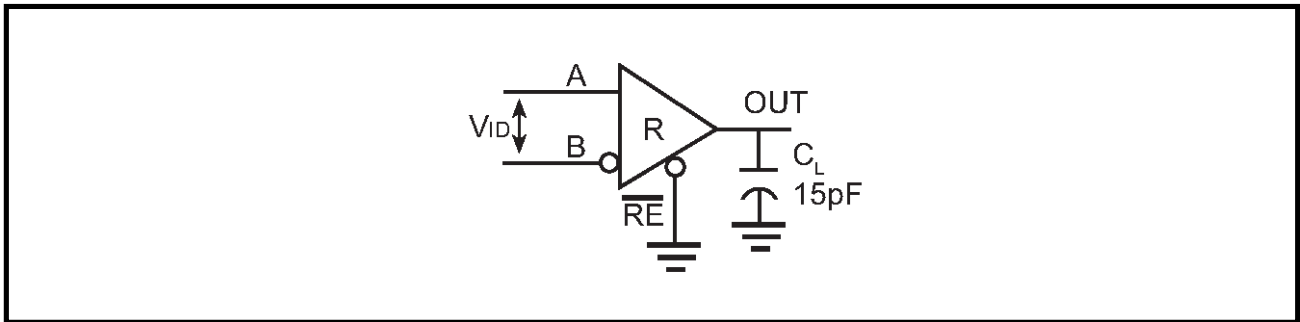


FIGURE 12. RS-485 RECEIVER PROPAGATION DELAY TIMING DIAGRAM

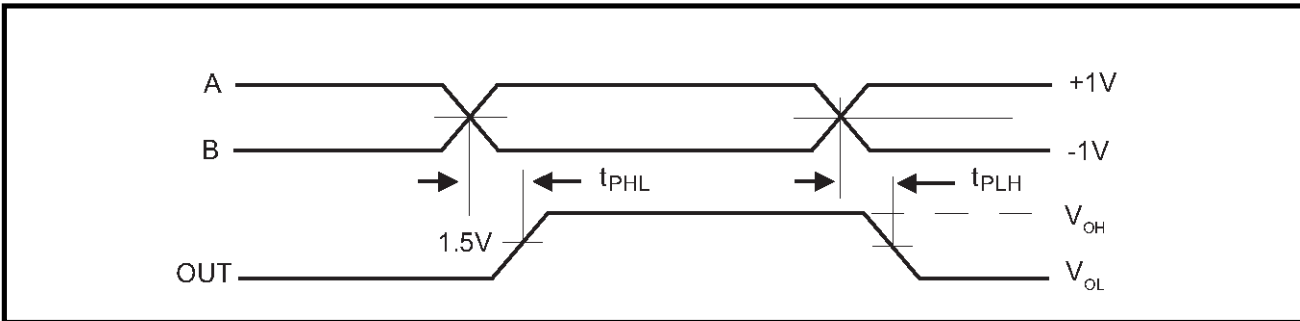


FIGURE 13. RS-485 RECEIVER ENABLE AND DISABLE TIMES TEST CIRCUIT

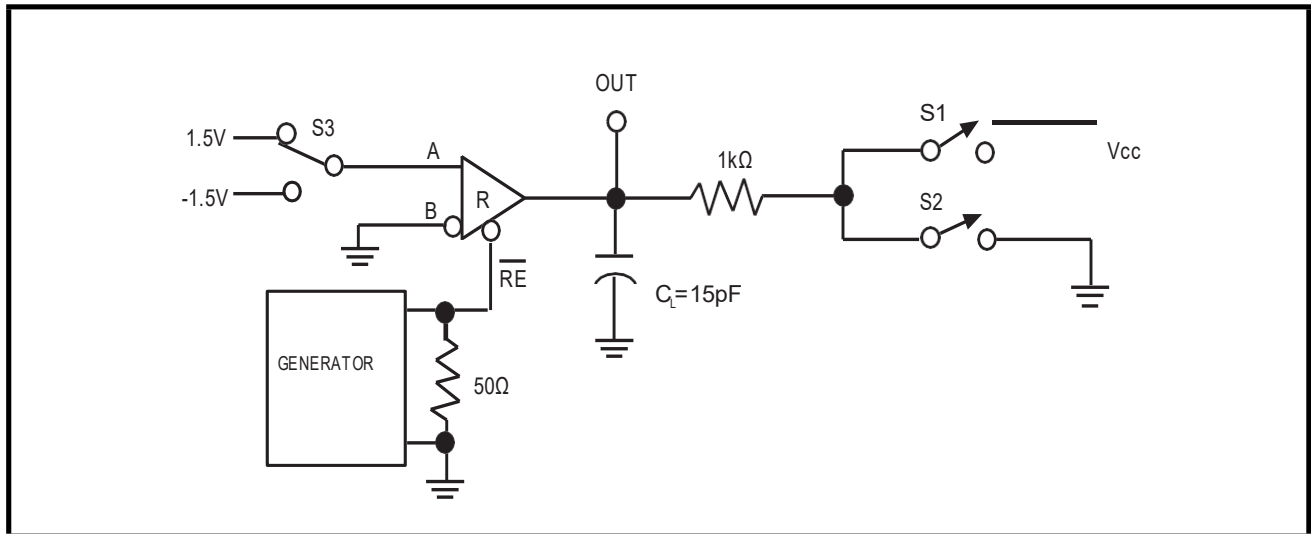


FIGURE 14. RS-485 RECEIVER ENABLE AND DISABLE TIMES TIMING DIAGRAM 1

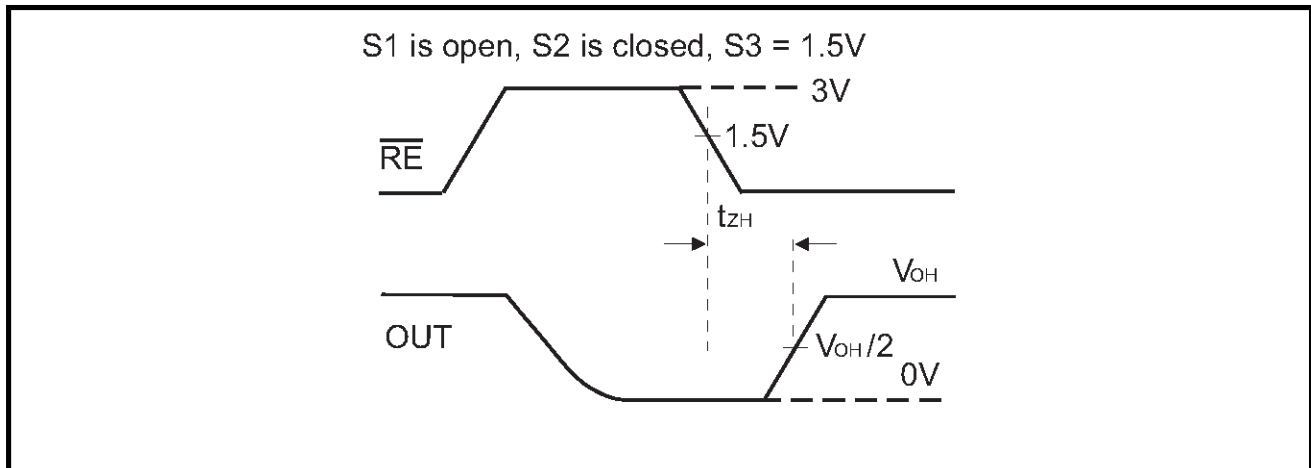


FIGURE 15. RS-485 RECEIVER ENABLE AND DISABLE TIMES TIMING DIAGRAM 2

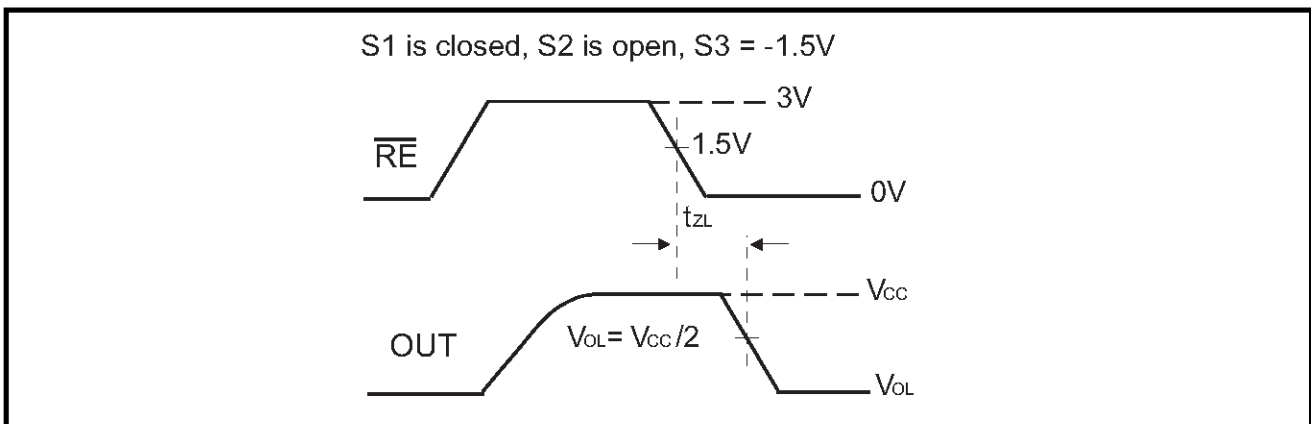


FIGURE 16. RS-485 RECEIVER ENABLE AND DISABLE TIMES TIMING DIAGRAM 3

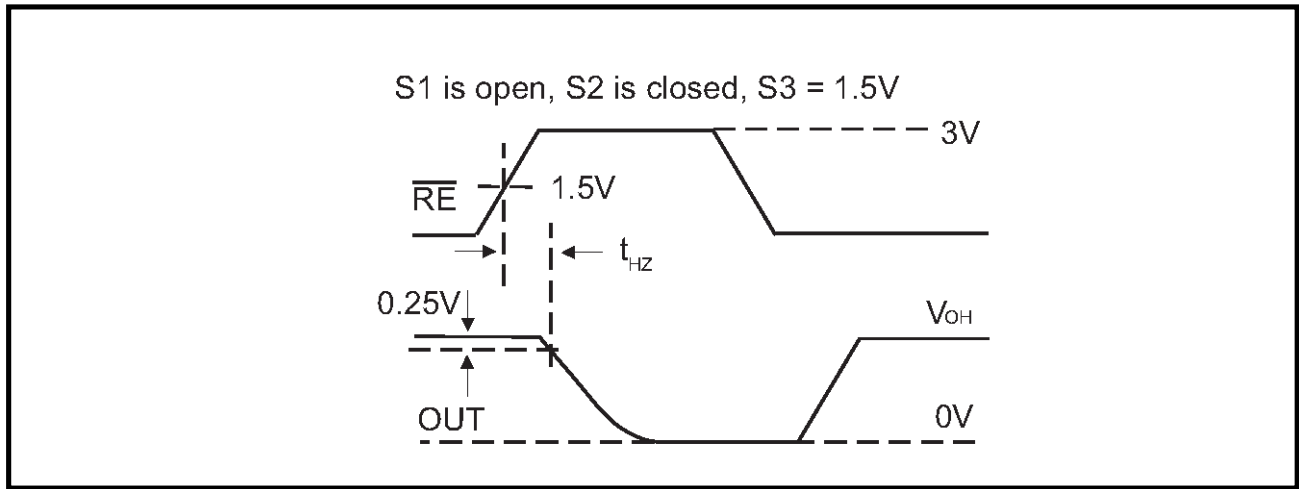


FIGURE 17. RS-485 RECEIVER ENABLE AND DISABLE TIMES TIMING DIAGRAM 4

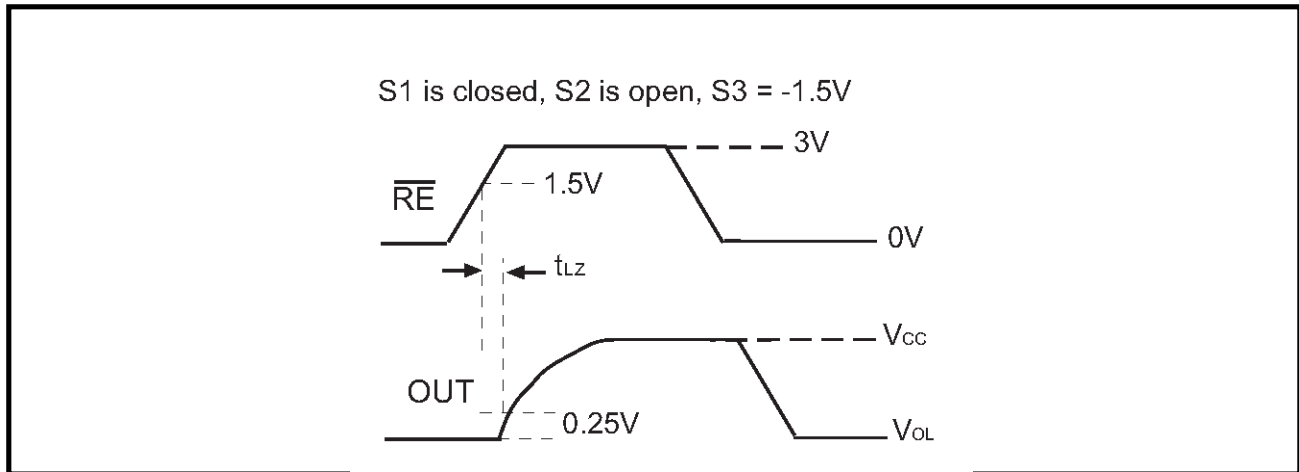


FIGURE 18. RS-232 DRIVER OUTPUT SLEW RATE TEST CIRCUIT

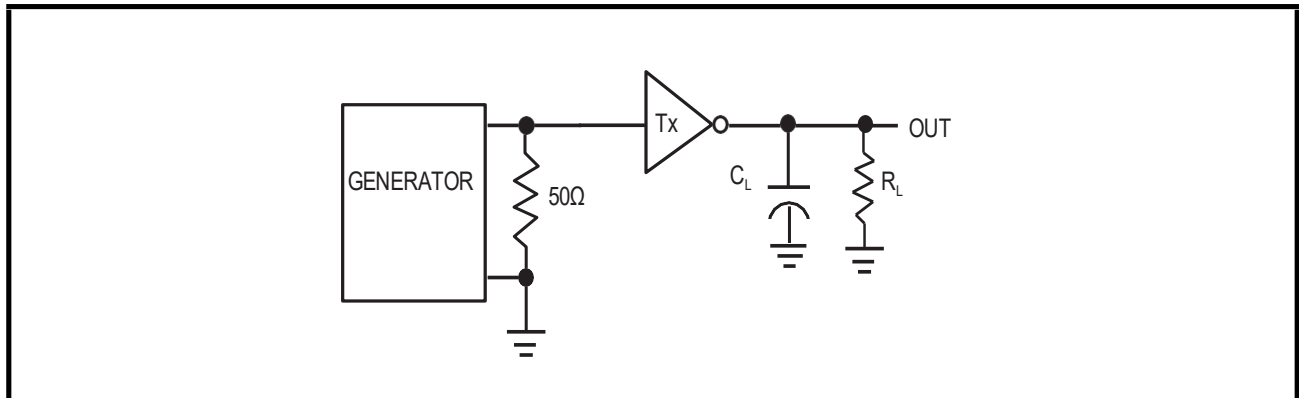


FIGURE 19. RS-232 DRIVER OUTPUT SLEW RATE TIMING DIAGRAM

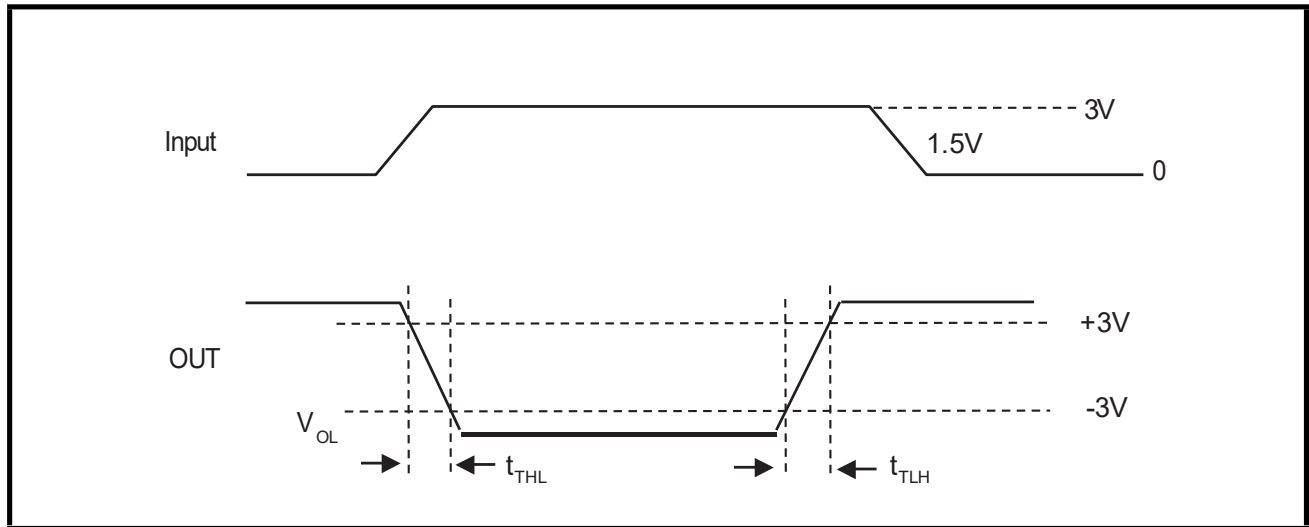


FIGURE 20. RS-232 RECEIVER PROPAGATION DELAY TEST CIRCUIT

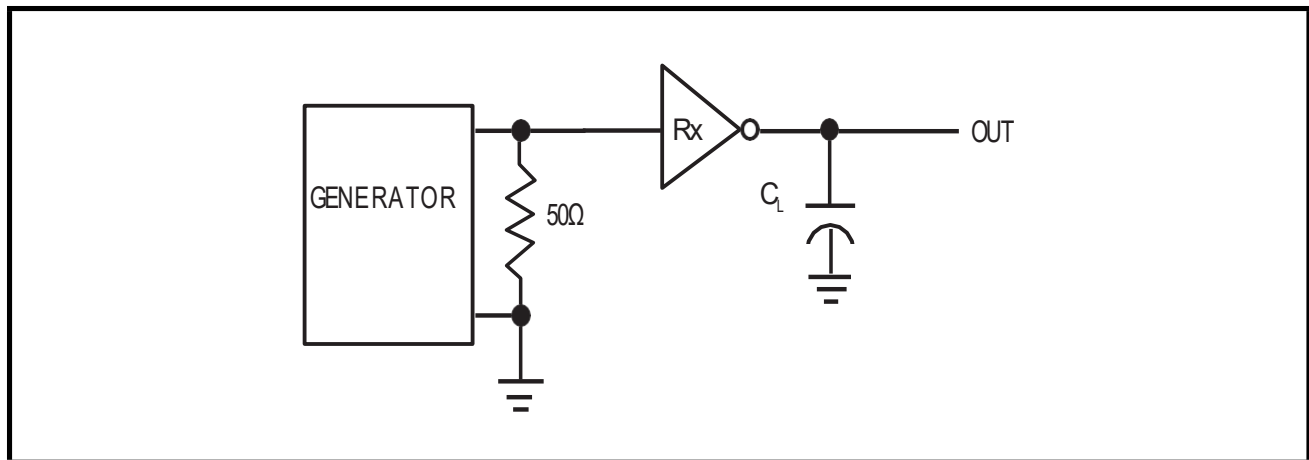
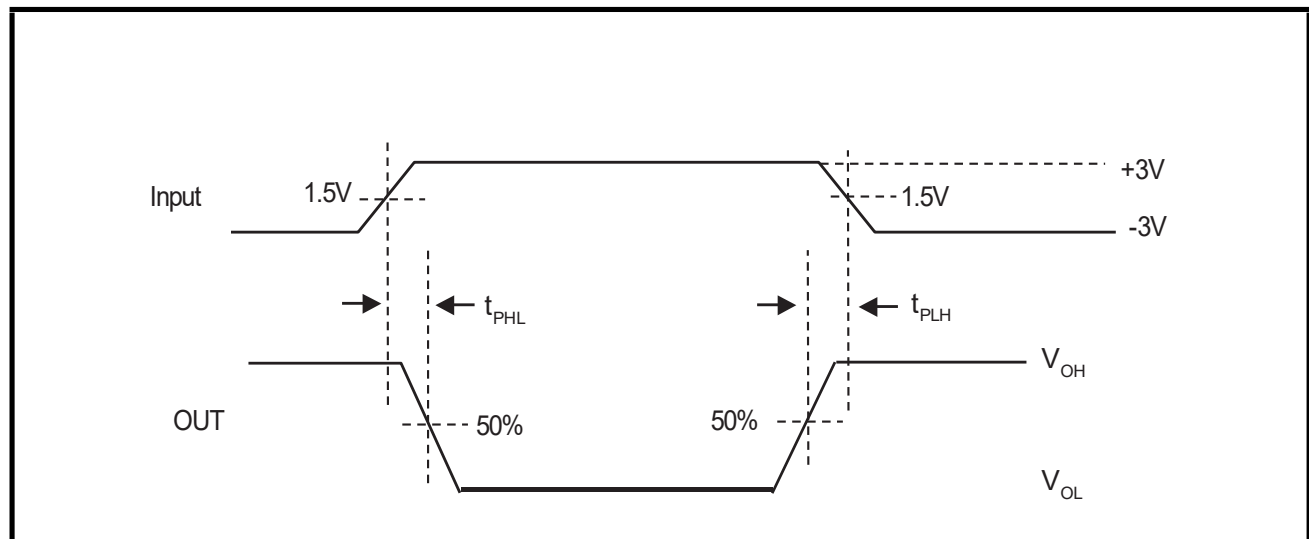


FIGURE 21. RS-232 RECEIVER PROPAGATION DELAY TIMING DIAGRAM



SP337E Mode Configuration Tables
TABLE 1: SP337EB

| $\overline{\text{RS232/RS485}}$ | TXEN | $\overline{\text{RXEN}}$ | 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 (High-Z Output) |
| High | Low | Low | RS-485/422 Full-Duplex | 2T/2R | ON | Drivers Disabled (High-Z Output); Receivers Enabled |
| High | High | High | RS-485/422 Full-Duplex | 2T/2R | ON | Drivers Enabled; Receivers Disabled (High-Z Output) |
| High | Low | High | RS-485/422 Full-Duplex | 2T/2R | ON | Drivers Disabled (High Z output); Receivers Disabled (High Z output) |
| High | High | Low | RS-485/422 Full-Duplex | 2T/2R | ON | Drivers Enabled; Receivers Enabled |

TABLE 2: SP337EU

| $\overline{\text{RS232/RS485}}$ | TXEN | $\overline{\text{RXEN}}$ | 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 (High-Z Output) |
| High | Low | Low | RS-485/422 Full-Duplex | 2T/2R | ON | Drivers Disabled (High-Z Output); Receivers Enabled |
| High | High | High | RS-485/422 Full-Duplex | 2T/2R | ON | Drivers Enabled; Receivers Disabled (High-Z Output) |
| High | Low | High | RS-485/422 Full-Duplex | 2T/2R | OFF (Shutdown) | Drivers Disabled (High Z output); Receivers Disabled (High Z output) |
| High | High | Low | RS-485/422 Full-Duplex | 2T/2R | ON | Drivers Enabled; Receivers Enabled |

FIGURE 22. 28 PIN TSSOP PACKAGE OUTLINE DRAWING

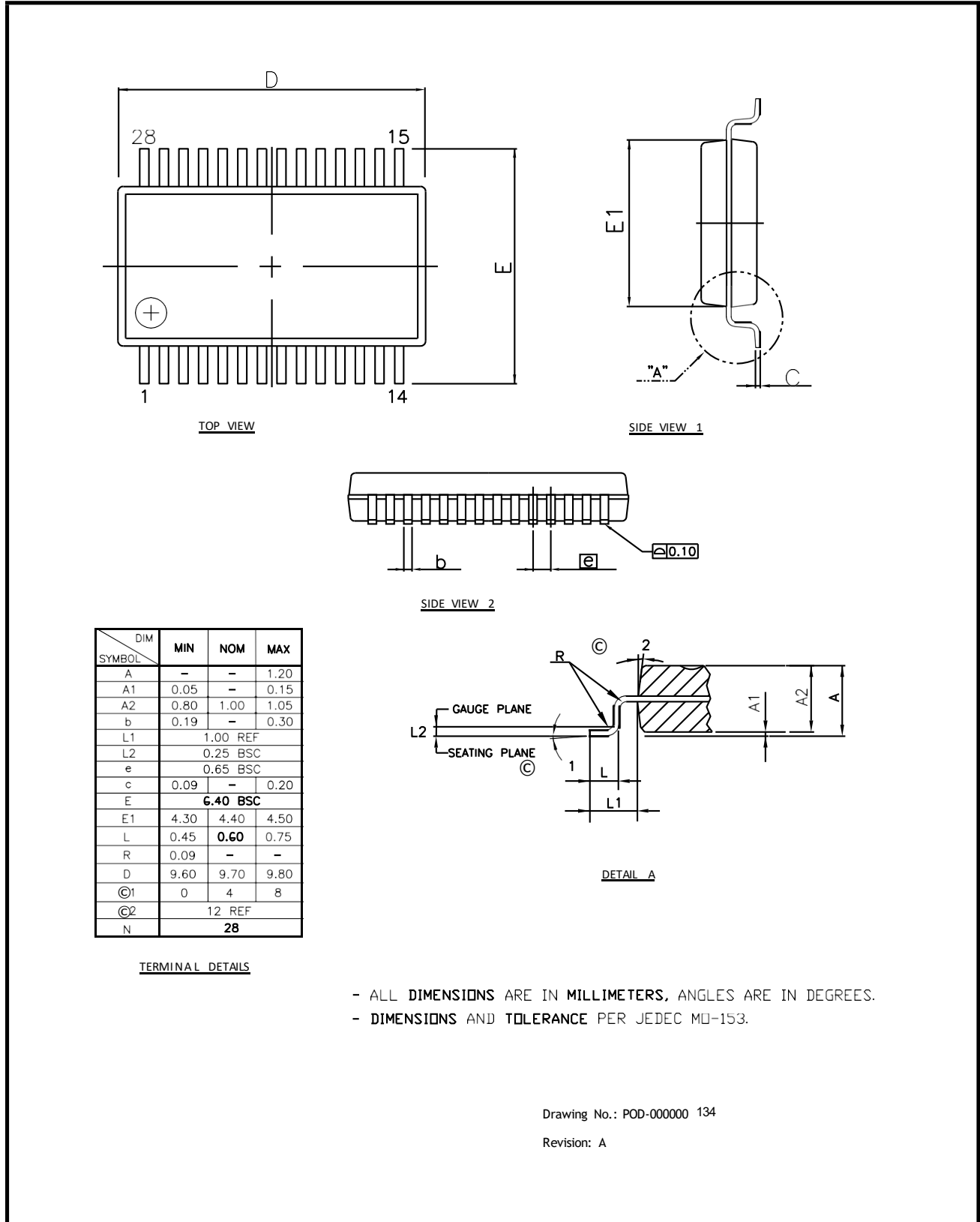


FIGURE 23. 28 PIN TSSOP RECOMMENDED LAND PATTERN AND STENCIL

