## GENERAL DESCRIPTION

The XR3160 is an advanced multiprotocol transceiver supporting RS-232, RS-485, and RS-422 serial standards. Full operation requires only four external charge pump capacitors.

The RS-485/$\overline{\text{RS-232}}$ pin selects RS-485 mode when high and RS-232 mode when low. The HALF/$\overline{\text{FULL}}$ pin configures the RS-485 modes as either half or full duplex.

The high speed drivers operate up to 20Mbps in RS-485/422 modes, and up to 1Mbps in RS-232 mode. All drivers can be slew limited to 250kbps in any mode to minimize electromagnetic interference (EMI) by setting the dedicated $\overline{\text{SLEW}}$ pin low.

All transmitter outputs and receiver inputs feature robust electrostatic discharge (ESD) protection to ±15kV IEC 61000-4-2 Airgap, ±15kV Human Body Model (HBM) and ±8kV IEC 61000-4-2 Contact. Each receiver output has full fail-safe protection to avoid system lockup, oscillation, or indeterminate states by defaulting to logic-high output level when the inputs are open, shorted, or terminated but undriven. No external biasing resistors are required.

The RS-232 receiver inputs include a 5kΩ pull-down to ground when in RS-232 mode. The RS-485/422 receiver inputs are high impedance (>96kΩ), allowing up to 256 devices on a single communication bus (1/8th unit load).

The XR3160 operates from a single power supply, 3V to 5.5V, with low idle current. The shutdown mode consumes less than 1µA in low power standby operation with RS-232 receivers enabled.

### FEATURES

- **Pin Compatible Upgrade** for MAX3160 (20 SSOP)
- IEC Level 4 ESD Protection
  - **±15kV IEC 61000-4-2 Air Gap Discharge**
  - **± 8kV IEC 61000-4-2 Contact Discharge**
  - ±15kV Human Body Model (HBM)
- **20Mbps RS-485** and 1Mbps RS-232 Data Rates
- Pin-Selectable 250kbps Slew Limiting
- **Single Supply Operation from +3V to +5.5V**
- 2 Drivers, 2 Receivers RS-232/V.28
- 1 Driver, 1 Receiver RS-485/422
  - Full or Half Duplex Configuration
  - 1/8th Unit Load, up to 256 receivers on bus
- RS-485/422 Enhanced Receiver Fail-safe for open, shorted, or terminated but idle inputs
- **10nA Shutdown Supply Current** (typical)

### TYPICAL APPLICATIONS

- Software Programmable Serial Ports (RS-232, RS-422, RS-485)
- Embedded and Industrial PCs (IPC)
- Process Control Equipment
- Point-Of-Sales Equipment
- Networking Equipment
- HVAC Controls Equipment
- Building Security and Automation

### ORDERING INFORMATION[1]

| PART NUMBER | OPERATING TEMPERATURE RANGE | LEAD-FREE | PACKAGE | PACKAGING METHOD |
|---|---|---|---|---|
| XR3160EIU-F | -40°C to +85°C | Yes[2] | 20-pin SSOP | Tube |
| XR3160EIUTR-F | | | | Tape and Reel |
| XR3160ECU-F | 0°C to +70°C | | | Tube |
| XR3160ECUTR-F | | | | Tape and Reel |

**NOTE:**

1. Refer to www.exar.com/XR3160 for most up-to-date Ordering Information.
2. Visit www.exar.com for additional information on Environmental Rating.

## 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 $V_{CC}$ | -0.3V to +6.0V |
| Voltage at TTL Input Pins | -0.3V to +6.0V |
| Receiver Input Voltage (from Ground) | ±18V |
| Driver Output Voltage (from Ground) | ±18V |
| Short Circuit Duration, TX out to Ground | Continuous |
| Storage Temperature Range | -65°C to +150°C |
| Lead Temperature (soldering, 10s) | +300°C |
| Power Dissipation 20-pin SSOP<br>(derate 12.0mW/°C above +70°C) | 662mW |
| ESD Ratings | |
| HBM - Human Body Model (Tx Output & Rx Input pins) | ±15kV |
| HBM - Human Body Model (all other pins) | ±3kV |
| IEC 61000-4-2 Airgap Discharge (Tx Output & Rx Input pins) | ±15kV |
| IEC 61000-4-2 Contact Discharge (Tx Output & Rx Input 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:**
$V_{CC}$ = +3V to +5.5V, C1-C4 = 0.1µF; $T_A = T_{MIN}$ to $T_{MAX}$. Typical values are at $V_{CC}$ = 3.3V, $T_A$ = +25°C.

| SYMBOL | PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | |
| $I_{CC}$ | Supply Current (RS-232) | | 1.2 | 2.5 | mA | No load, Idle inputs, RS-485/$\overline{\text{RS-232}}$ = 0V |
| $I_{CC}$ | Supply Current (RS-485/422) | | 2.5 | 5.5 | mA | No load, Idle inputs, RS-485/$\overline{\text{RS-232}}$ = $V_{CC}$ |
| $I_{CC}$ | $V_{CC}$ Shutdown Current | | 0.01 | 1 | µA | $\overline{\text{SHDN}}$ = 0V, Receiver inputs open or grounded |
| **TRANSMITTER and LOGIC INPUT PINS (DI, T1IN, T2IN, DE, $\overline{\text{SHDN}}$, $\overline{\text{SLEW}}$, HALF/$\overline{\text{FULL}}$, RS-485/$\overline{\text{RS-232}}$)** | | | | | | |
| $V_{IL}$ | Logic Input Voltage Low | | | 0.8 | V | |
| $V_{IH}$ | Logic Input Voltage High | 2.0 | | | V | $V_{CC}$ = +3.3V |
| $V_{IH}$ | Logic Input Voltage High | 2.4 | | | V | $V_{CC}$ = +5.0V |
| $I_{INL}$ | Logic Input Leakage Current | | ±0.01 | ±1 | µA | |
| $V_{HYS}$ | Logic Input Hysteresis | | 0.2 | | V | |
| **RS-232 and RS-485/422 RECEIVER OUTPUTS (R1OUT, R2OUT, RO)** | | | | | | |
| $V_{OL}$ | Receiver Output Voltage Low | | | 0.4 | V | $I_{OUT}$ = 2.5mA |
| $V_{OH}$ | Receiver Output Voltage High | $V_{CC}$-0.6 | | | V | $I_{OUT}$ = -1.5mA |
| $I_{OSS}$ | Receiver Output Short Circuit Current | | ±20 | ±85 | mA | $0 \le V_O \le V_{CC}$ |
| $I_{OZ}$ | Receiver Output Leakage Current | | ±0.05 | ±1 | µA | $0 \le V_O \le V_{CC}$, Receivers disabled |

## ELECTRICAL CHARACTERISTICS (Continued)

**UNLESS OTHERWISE NOTED:**
$V_{CC}$ = +3V to +5.5V, C1-C4 = 0.1µF; $T_A$ = $T_{MIN}$ to $T_{MAX}$. Typical values are at $V_{CC}$ = 3.3V, $T_A$ = +25°C.

| SYMBOL | PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|---|---|---|---|---|---|---|
| **RS-232 SINGLE-ENDED RECEIVER INPUTS (R1IN, R2IN)** | | | | | | |
| $V_{IN}$ | Input Voltage Range | -15 | | +15 | V | |
| $V_{IL}$ | Input Threshold Low | 0.6 | 1.2 | | V | $V_{CC}$ = +3.3V |
| | | 0.8 | 1.5 | | V | $V_{CC}$ = +5.0V |
| $V_{IH}$ | Input Threshold High | | 1.5 | 2.0 | V | $V_{CC}$ = +3.3V |
| | | | 1.8 | 2.4 | V | $V_{CC}$ = +5.0V |
| $V_{HYS}$ | Input Hysteresis | | 0.5 | | V | |
| $R_{IN}$ | Input Resistance | 3 | 5 | 7 | kΩ | $V_{CC}$ = +3.0V to 5.5V |
| **RS-232 SINGLE-ENDED TRANSMITTER OUTPUTS (T1OUT, T2OUT)** | | | | | | |
| $V_{OUT}$ | Output Voltage Swing | ±5.0 | ±5.4 | | V | Outputs loaded with 3kΩ to Gnd |
| $R_{OFF}$ | Output Power Off Impedance | 300 | 10M | | Ω | $V_{CC}$ = 0V, $V_{OUT}$ = ±2V |
| $I_{SC}$ | Output Short Circuit Current | | ±30 | ±60 | mA | $V_{OUT}$ = 0V |
| $I_O$ | Output Leakage Current | | | ±125 | µA | $\overline{SHDN}$ = 0V, $V_{OUT}$ = ±9V, $V_{CC}$ = 0V or 5.5V |

## ELECTRICAL CHARACTERISTICS (Continued)

**UNLESS OTHERWISE NOTED:**
$V_{CC}$ = +3V to +5.5V, C1-C4 = 0.1µF; $T_A = T_{MIN}$ to $T_{MAX}$. Typical values are at $V_{CC}$ = 3.3V, $T_A$ = +25°C.

| SYMBOL | PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|---|---|---|---|---|---|---|
| **RS-485/422 DIFFERENTIAL RECEIVER INPUTS (A,B)** | | | | | | |
| $R_{IN}$ | Receiver Input Resistance | 96 | | | kΩ | -7V ≤ $V_{CM}$ ≤ +12V |
| $I_{IN}$ | Receiver Input Current | | | 125 | µA | $V_{IN}$ = +12V |
| | | | | -100 | µA | $V_{IN}$ = -7V |
| $V_{TH}$ | Receiver Differential Threshold Voltage | -200 | -125 | -50 | mV | -7V ≤ $V_{CM}$ ≤ +12V |
| $\Delta V_{TH}$ | Receiver Input Hysteresis | | 30 | | mV | |
| **RS-485/422 DIFFERENTIAL DRIVER OUTPUTS (Y, Z)** | | | | | | |
| $V_{OD}$ | Differential Driver Output | 1.5 | | $V_{CC}$ | V | $R_L$ = 54Ω (RS-485), Figure 4 |
| | | 1.5 | | $V_{CC}$ | V | -7V ≤ $V_{CM}$ ≤ +12V, Figure 5 |
| | | 2 | | $V_{CC}$ | V | $R_L$ = 100Ω (RS-422), Figure 4 |
| $\lvert\Delta V_{OD}\rvert$ | Change In Magnitude of Differential Output Voltage | | | 0.2 | V | $R_L$ = 54Ω or 100Ω, Figure 4 |
| $V_{CM}$ | Driver Common Mode Output Voltage | | | 3 | V | $R_L$ = 54Ω or 100Ω, Figure 4 |
| $\lvert\Delta V_{CM}\rvert$ | Change In Magnitude of Common Mode Output Voltage | | | 0.2 | V | $R_L$ = 54Ω or 100Ω, Figure 4 |
| $I_{OSD}$ | Driver Output Short Circuit Current | | | ±250 | mA | -7V ≤ $V_Y$ or $V_Z$ ≤ +12V, Figure 6 |
| $I_O$ | Driver Output Leakage Current | | | ±125 | µA | DE = 0V or $\overline{SHDN}$ = 0V, $V_Y$ or $V_Z$ = -7V or +12V, $V_{CC}$ = 0V or 5.25V |

## TIMING CHARACTERISTICS

**UNLESS OTHERWISE NOTED:**
$V_{CC}$ = +3V to +5.5V, C1-C4 = 0.1µF; $T_A = T_{MIN}$ to $T_{MAX}$. Typical values are at $V_{CC}$ = 3.3V, $T_A$ = +25°C

| SYMBOL | PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|---|---|---|---|---|---|---|
| **ALL MODES** | | | | | | |
| $t_{ENABLE}$ | Enable from Shutdown | | 1000 | | ns | |
| $t_{SHUTDOWN}$ | Enable to Shutdown | | 1000 | | ns | |
| **RS-232, DATA RATE = 250kbps ($\overline{SLEW}$ = 0V), ONE TRANSMITTER SWITCHING** | | | | | | |
| | Maximum Data Rate | 250 | | | kbps | $R_L$ = 3kΩ, $C_L$ = 1000pF |
| $t_{RHL}$, $t_{RLH}$ | Receiver Propagation Delay | | 100 | | ns | $C_L$ = 150pF, Figure 7 |
| $\lvert t_{RHL}-t_{RLH}\rvert$ | Receiver Propagation Delay Skew | | | 100 | ns | |
| $t_{DHL}$, $t_{DLH}$ | Driver Propagation Delay | | 1400 | | ns | $R_L$ = 3kΩ, $C_L$ = 2500pF, Figure 8 |
| $\lvert t_{DHL}-t_{DLH}\rvert$ | Driver Propagation Delay Skew | | | 600 | ns | |
| | | | | | | |
| $t_{SHL}$, $t_{SLH}$ | Transition Region Slew Rate from +3.0V to -3.0V or -3.0V to +3.0V | 6 | | 30 | V/µs | $V_{CC}$ = +3.3V, $R_L$ = 3kΩ to 7kΩ, $C_L$ = 150pF to 2500pF, $T_A$ = 25°C, Figure 8 |
| $t_{SHL}$, $t_{SLH}$ | Transition Region Slew Rate from +3.0V to -3.0V or -3.0V to +3.0V | 4 | | 30 | V/µs | $V_{CC}$ = +3.3V, $R_L$ = 3kΩ to 7kΩ, $C_L$ = 150pF to 2500pF, Figure 8 |
| **RS-232, DATA RATE = 1Mbps ($\overline{SLEW}$ = $V_{CC}$), ONE TRANSMITTER SWITCHING** | | | | | | |
| | Maximum Data Rate | 1 | | | Mbps | $R_L$ = 3kΩ, $C_L$ = 250pF |
| $t_{RHL}$, $t_{RLH}$ | Receiver Propagation Delay | | 100 | | ns | $C_L$ = 150pF, Figure 7 |
| $\lvert t_{RHL}-t_{RLH}\rvert$ | Receiver Propagation Delay Skew | | | 100 | ns | |
| $t_{DHL}$, $t_{DLH}$ | Driver Propagation Delay | | 300 | | ns | $R_L$ = 3kΩ, $C_L$ = 1000pF, Figure 8 |
| $\lvert t_{DHL}-t_{DLH}\rvert$ | Driver Propagation Delay Skew | | | 150 | ns | |
| | | | | | | |
| $t_{SHL}$, $t_{SLH}$ | Transition Region Slew Rate from +3.0V to -3.0V or -3.0V to +3.0V | 13 | | 150 | V/µs | $V_{CC}$ = +3.3V, $R_L$ = 3kΩ to 7kΩ, $C_L$ = 150pF to 1000pF, Figure 8 |
| $t_{SHL}$, $t_{SLH}$ | Transition Region Slew Rate from +3.0V to -3.0V or -3.0V to +3.0V | 24 | | 150 | V/µs | $V_{CC}$ = +3.3V, $R_L$ = 3kΩ to 7kΩ, $C_L$ = 150pF to 1000pF, $T_A$ = 25°C, Figure 8 |

## TIMING CHARACTERISTICS (Continued)

**UNLESS OTHERWISE NOTED:**
$V_{CC}$ = +3V to +5.5V, C1-C4 = 0.1µF; $T_A = T_{MIN}$ to $T_{MAX}$. Typical values are at $V_{CC}$ = 3.3V, $T_A$ = +25°C.

| SYMBOL | PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|---|---|---|---|---|---|---|
| **RS-485/RS-422, DATA RATE = 250kbps ($\overline{SLEW}$ = 0V), ONE TRANSMITTER SWITCHING** | | | | | | |
| | Maximum Data Rate | 250 | | | kbps | $R_L$ = 54Ω, $C_L$ = 50pF |
| $t_{RPHL}$, $t_{RPLH}$ | Receiver Propagation Delay | | 50 | 150 | ns | $C_L$ = 15pF, Figure 9 |
| $\lvert t_{RPHL}-t_{RPLH}\rvert$ | Receiver Propagation Delay Skew | | | 10 | ns | |
| $t_{DPHL}$, $t_{DPLH}$ | Driver Propagation Delay | | 500 | 1000 | ns | $R_L$ = 54Ω, $C_L$ = 50pF, Figure 10 |
| $\lvert t_{DPHL}-t_{DPLH}\rvert$ | Driver Propagation Delay Skew | | | 100 | ns | |
| $t_{DR}$, $t_{DF}$ | Driver Rise and Fall Time | 300 | 650 | 1200 | ns | |
| | | | | | | |
| $t_{DZH}$, $t_{DZL}$ | Driver Output Enable Time | | | 1000 | ns | $R_L$ = 500Ω, $C_L$ = 50pF, Figure 11 |
| $t_{DHZ}$, $t_{DLZ}$ | Driver Output Disable Time | | | 200 | ns | |
| **RS-485/RS-422, DATA RATE = 20Mbps ($\overline{SLEW}$ = $V_{CC}$), ONE TRANSMITTER SWITCHING** | | | | | | |
| | Maximum Data Rate | 20 | | | Mbps | $R_L$ = 54Ω, $C_L$ = 50pF |
| $t_{RPHL}$, $t_{RPLH}$ | Receiver Propagation Delay | | 50 | 150 | ns | $C_L$ = 15pF, Figure 9 |
| $\lvert t_{RPHL}-t_{RPLH}\rvert$ | Receiver Propagation Delay Skew | | | 10 | ns | |
| $t_{DPHL}$, $t_{DPLH}$ | Driver Propagation Delay | | 30 | 100 | ns | $R_L$ = 54Ω, $C_L$ = 50pF, Figure 10 |
| $\lvert t_{DPHL}-t_{DPLH}\rvert$ | Driver Propagation Delay Skew | | | 10 | ns | |
| $t_{DR}$, $t_{DF}$ | Driver Rise and Fall Time | | 10 | 20 | ns | |
| | | | | | | |
| $t_{DZH}$, $t_{DZL}$ | Driver Output Enable Time | | | 200 | ns | $R_L$ = 500Ω, $C_L$ = 50pF, Figure 11 |
| $t_{DHZ}$, $t_{DLZ}$ | Driver Output Disable Time | | | 200 | ns | |

## PIN DESCRIPTIONS

| Pin | Name | RS-232 | RS-485 Full Duplex | RS-485 Half Duplex |
|---|---|---|---|---|
| 1 | C1+ | Charge pump cap 1 positive lead, 0.1µF | | |
| 2 | VCC | Main Supply, $V_{CC}$ = +3.0V to +5.5V, bypass to ground with 1.0µF | | |
| 3 | C1- | Charge pump cap 1 negative lead | | |
| 4 | GND | Ground | | |
| 5 | T1OUT, B/Z | Transmitter 1 Output | Z Driver Neg Output | B/Z Neg Input/Output |
| 6 | T2OUT, A/Y | Transmitter 2 Output | Y Driver Pos Output | A/Y Pos Input/Output |
| 7 | R1OUT | Receiver 1 Output | X | X |
| 8 | R2OUT, RO | Receiver 2 Output | Receiver TTL Output | Receiver TTL Output |
| 9 | $\overline{\text{SHDN}}$ | Low power shutdown mode when low | | |
| 10 | $\overline{\text{SLEW}}$ | Data rate limited to 250kbps when low | | |
| 11 | RS-485/$\overline{\text{RS-232}}$ | 0 | 1 | 1 |
| 12 | HALF/$\overline{\text{FULL}}$ | X | 0 | 1 |
| 13 | R2IN, A | Receiver 2 Input | A Pos Receiver Input | X |
| 14 | R1IN, B | Receiver 1 Input | B Neg Receiver Input | X |
| 15 | T2IN, DE | Transmitter 2 Input | Driver enabled when high | |
| 16 | T1IN, DI | Transmitter 1 Input | Driver TTL Input | |
| 17 | V- | Charge pump negative supply, 0.1µF from ground | | |
| 18 | C2- | Charge pump cap 2 negative lead | | |
| 19 | C2+ | Charge pump cap 2 positive lead, 0.1µF | | |
| 20 | V+ | Charge pump positive supply, 0.1µF to ground | | |

## SUGGESTED DB9 CONNECTOR PINOUT

| DB9 Pin | RS-232 | RS-485 Full Duplex | RS-485 Half Duplex |
|---|---|---|---|
| 1 | | | |
| 2 | RXD | RX+ | |
| 3 | TXD | TX- | Data- |
| 4 | | | |
| 5 | Ground | | |
| 6 | | | |
| 7 | RTS | TX+ | Data+ |
| 8 | CTS | RX- | |
| 9 | | | |

## BLOCK DIAGRAMS

FIGURE 1. RS-232 MODE

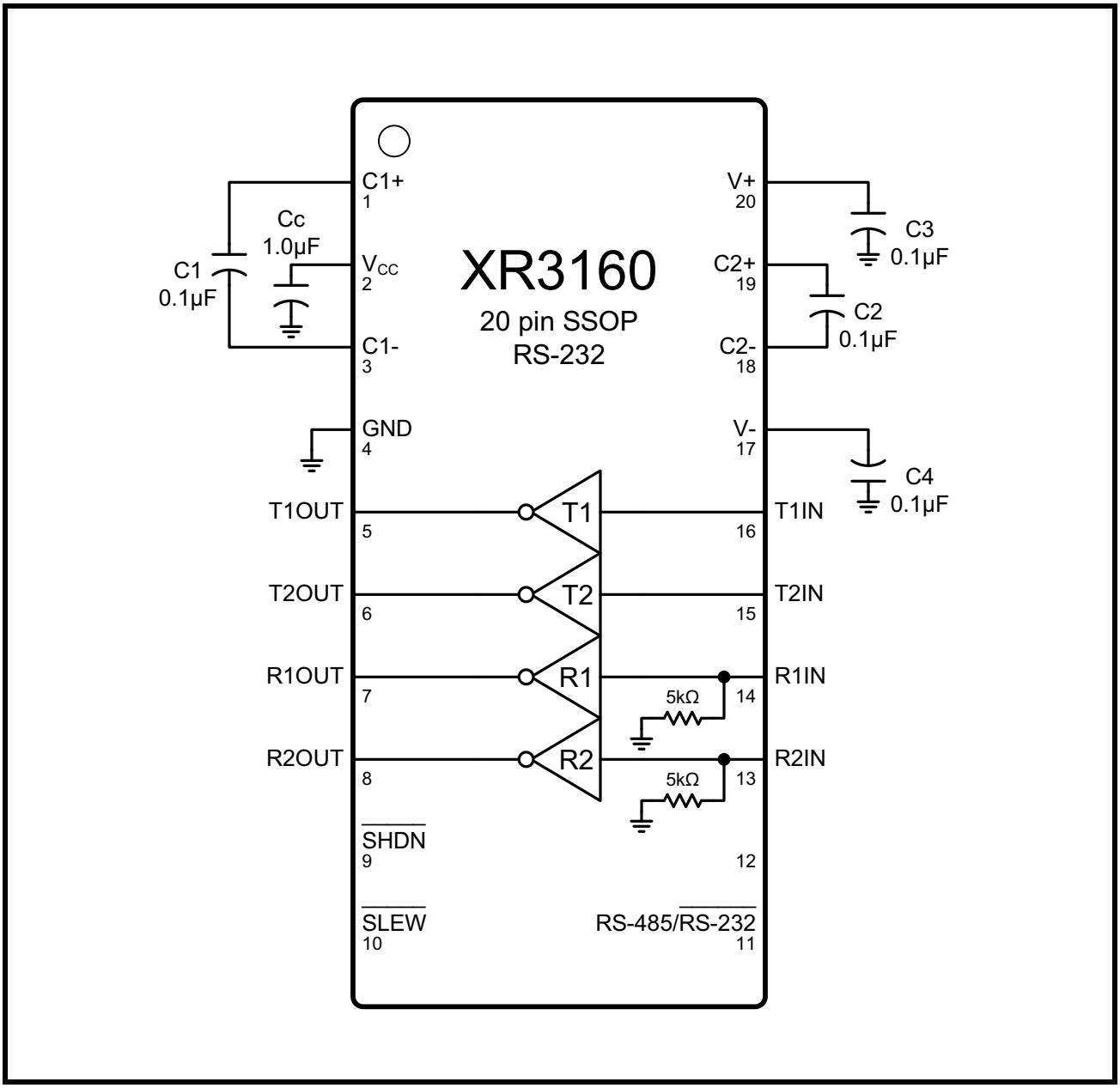


FIGURE 2. RS-485/422 FULL DUPLEX MODE

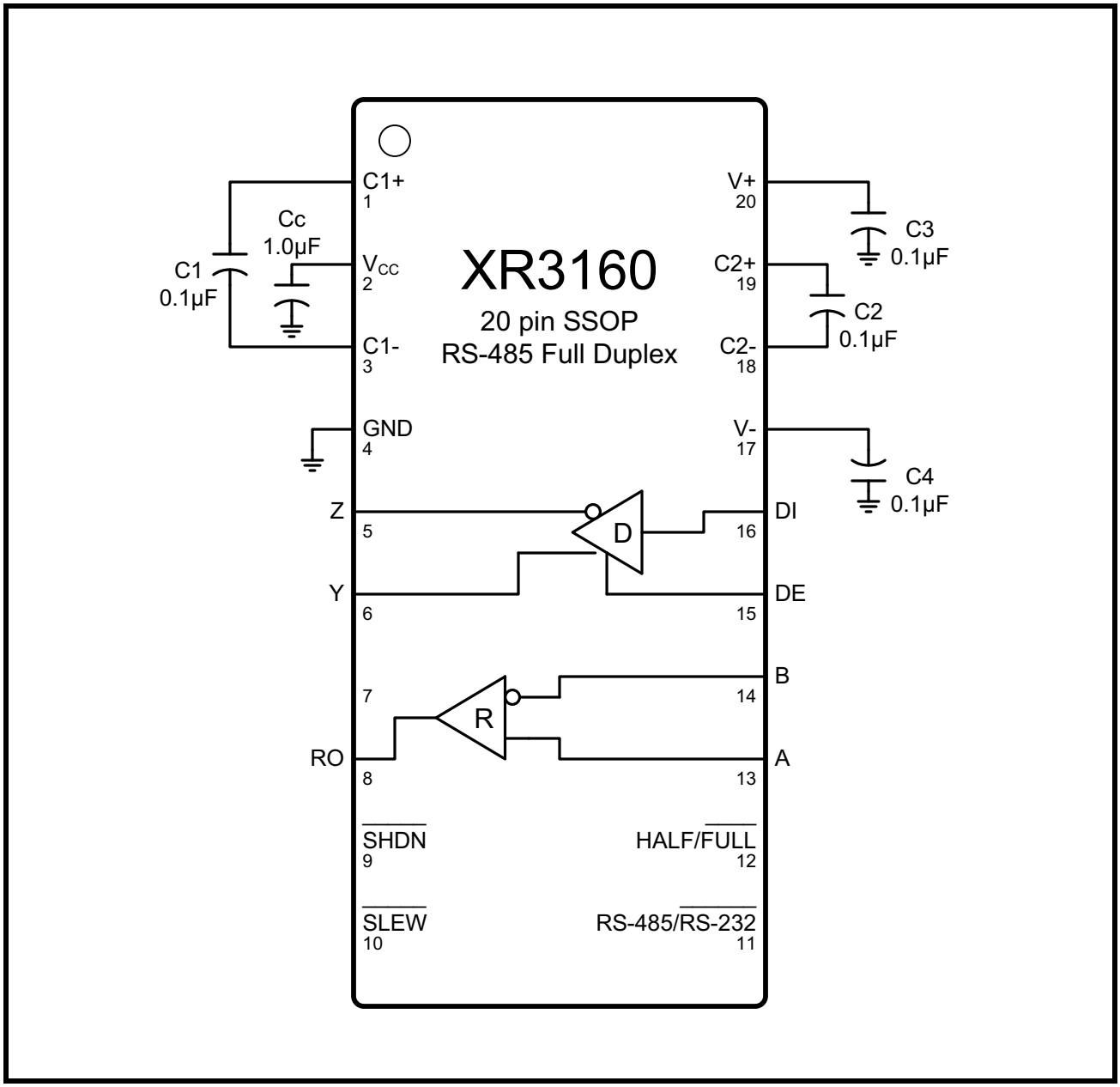
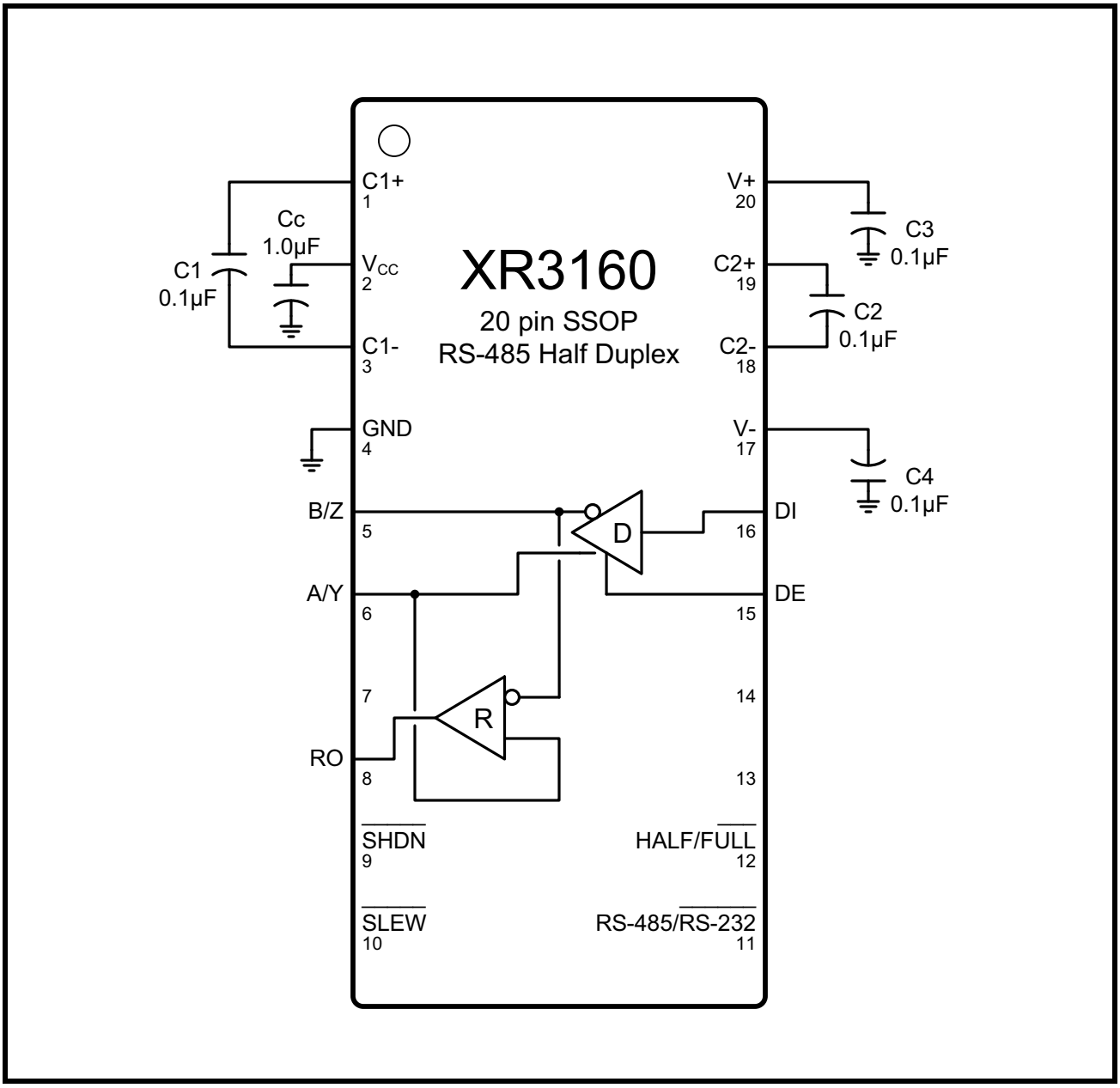


FIGURE 3. RS-485 HALF DUPLEX MODE



## TEST CIRCUITS

FIGURE 4. RS-485/422 DIFFERENTIAL DRIVER OUTPUT VOLTAGE

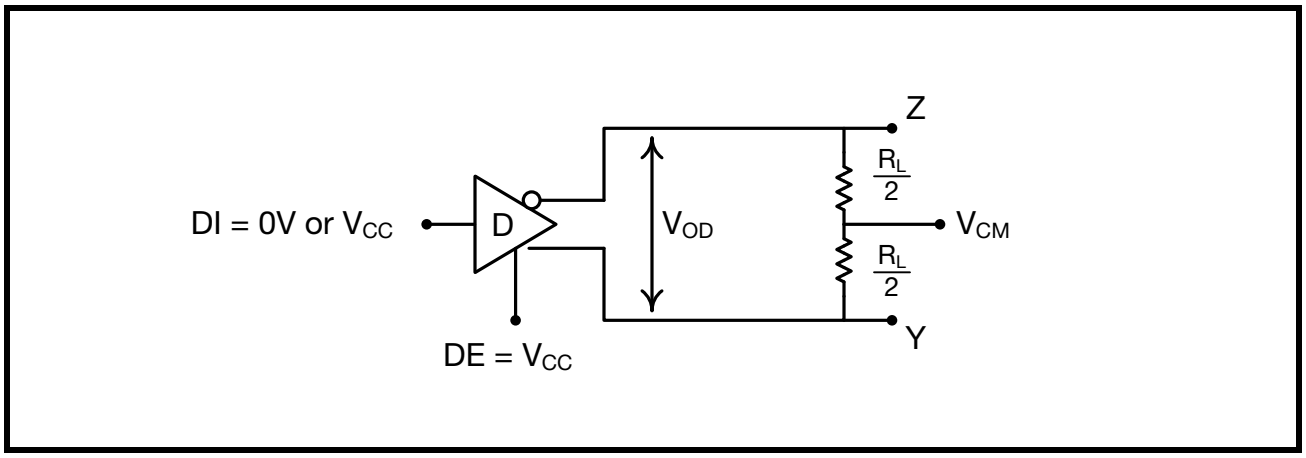



FIGURE 5. RS-485/422 DIFFERENTIAL DRIVER OUTPUT VOLTAGE OVER COMMON MODE

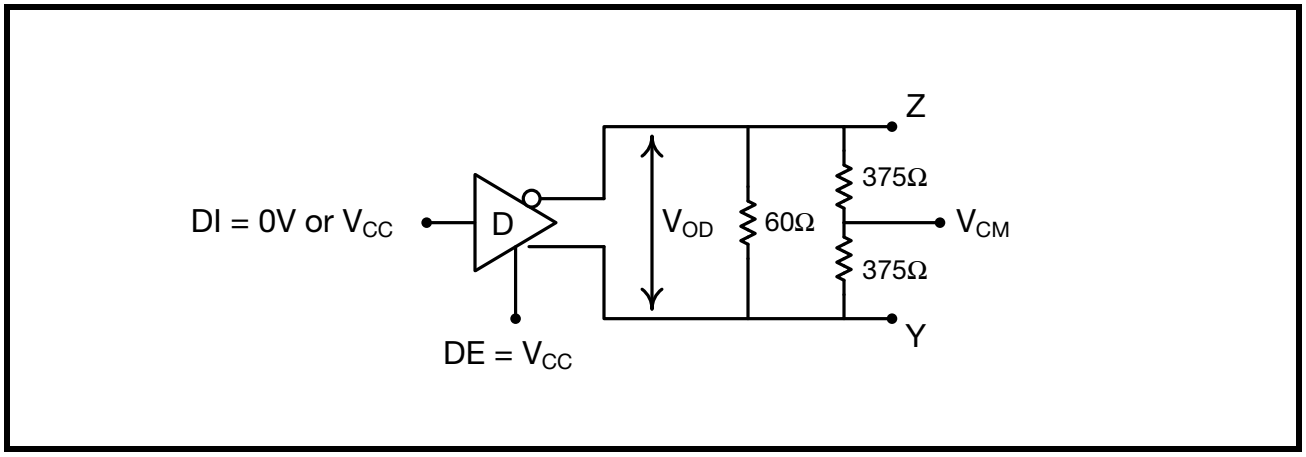



FIGURE 6. RS-485/422 DRIVER OUTPUT SHORT CIRCUIT CURRENT

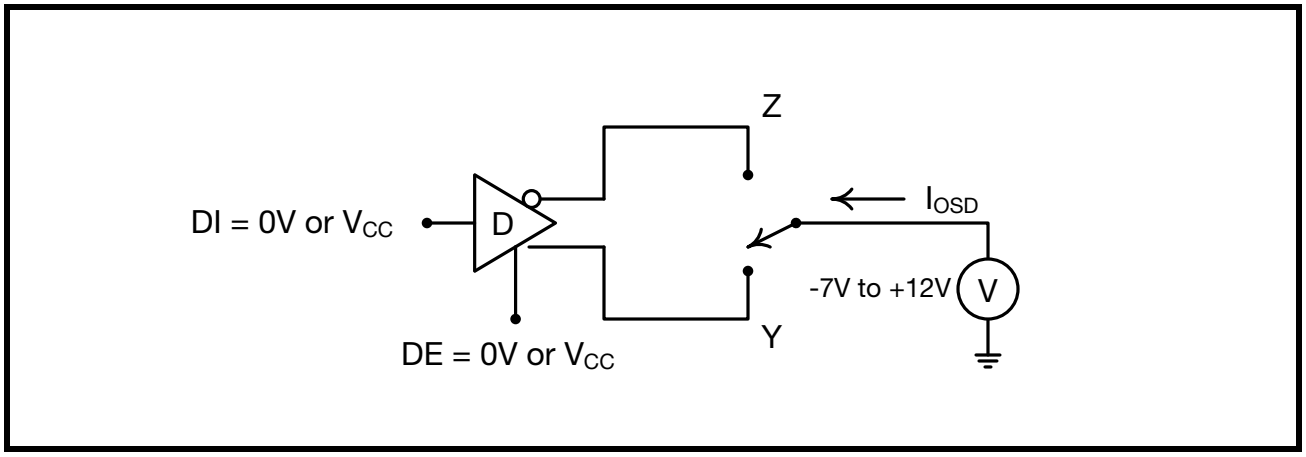


FIGURE 7. RS-232 RECEIVER PROPAGATION DELAY

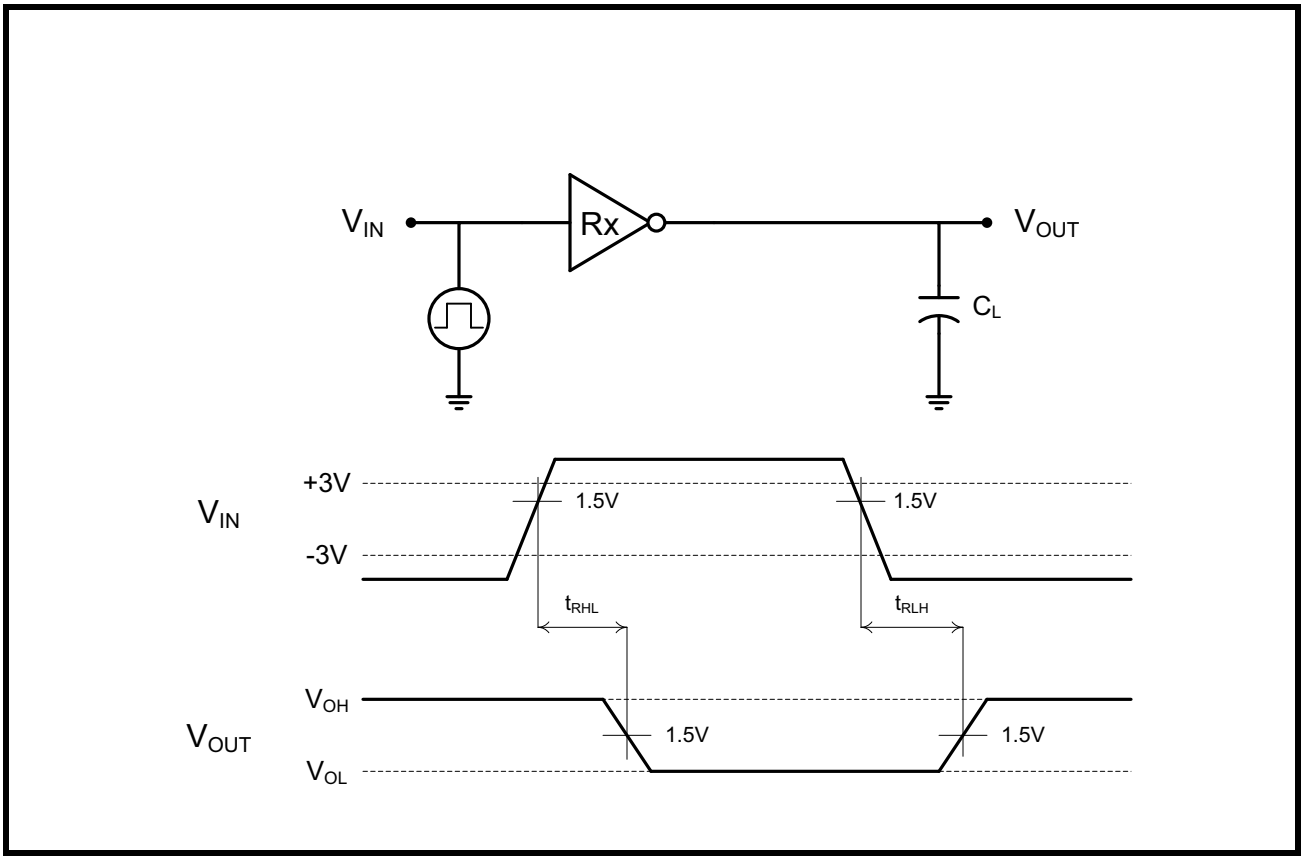


**FIGURE 8. RS-232 DRIVER PROPAGATION DELAY**

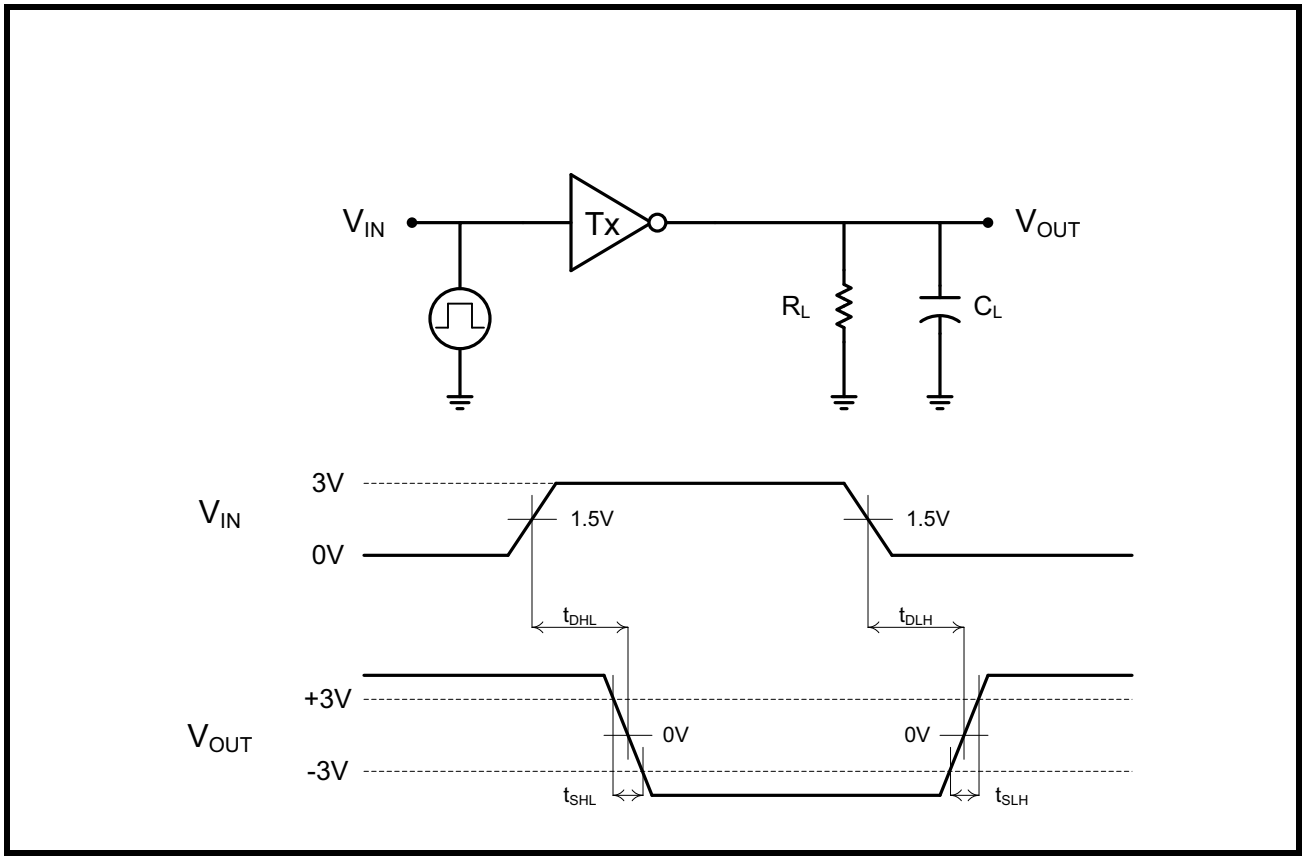
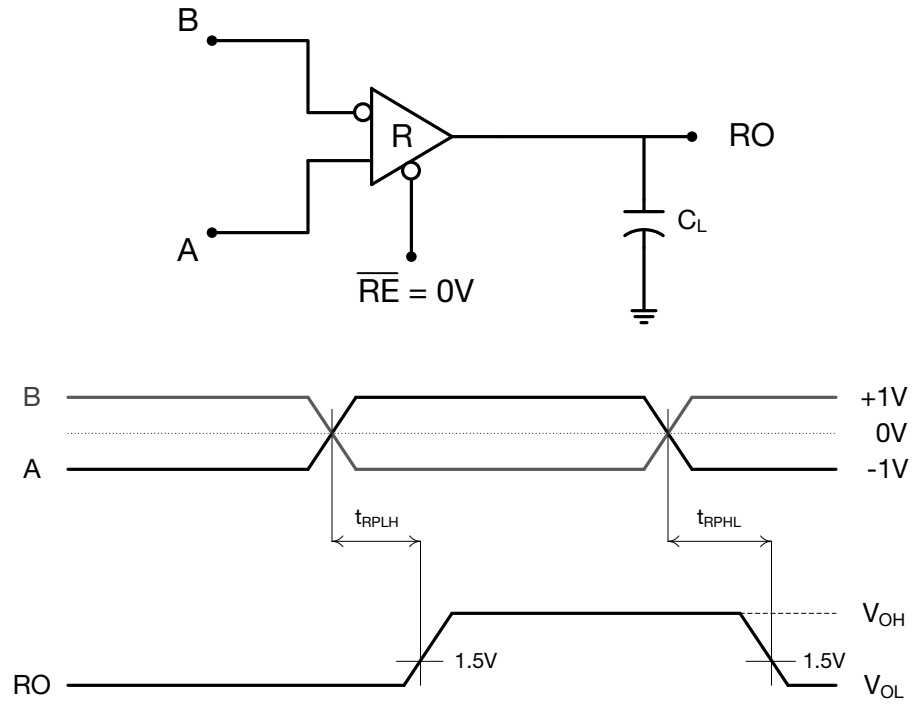


FIGURE 9. RS-485/422 RECEIVER PROPAGATION DELAY




The $\overline{RE}$ control is internally fixed to 0V in the RS-485/422 modes (receiver always on).

FIGURE 10. RS-485/422 DRIVER PROPAGATION DELAY AND RISE/FALL TIMES

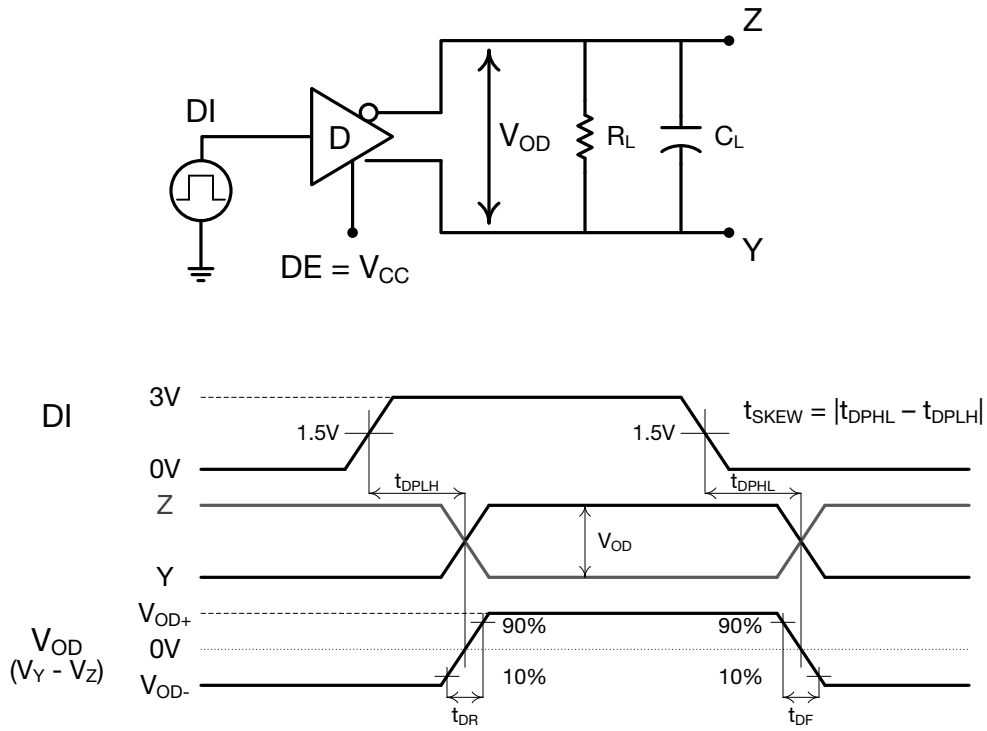
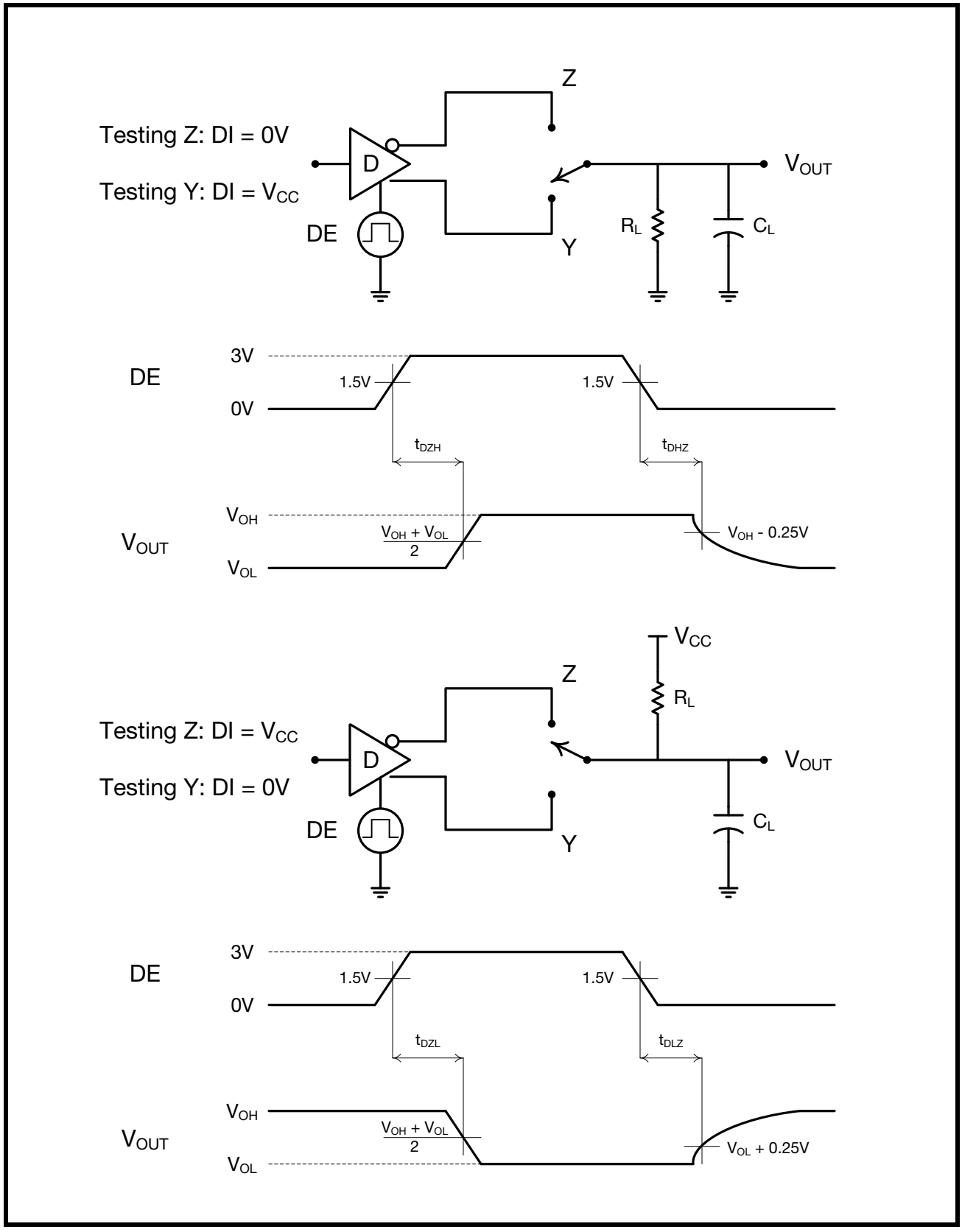


FIGURE 11. RS-485/422 DRIVER OUTPUT ENABLE/DISABLE TIMES



## PRODUCT SUMMARY

The XR3160 is an advanced multiprotocol transceiver supporting RS-232, RS-485, and RS-422 serial standards. Full operation requires only four external charge pump capacitors.

### ENHANCED FAILSAFE

The enhanced failsafe feature of the XR3160 guarantees a logic-high receiver output when the receiver inputs are open, shorted, or terminated but idle/undriven. The enhanced failsafe interprets 0V differential as a logic high with a minimum 50mV noise margin, while maintaining compliance with the EIA/TIA-485 standard of ±200mV. No external biasing resistors are required, further easing the usage of multiple protocols over a single connector.

### ±15kV ESD PROTECTION

ESD protection structures are incorporated on all pins to protect against electrostatic discharges encountered during handling and assembly. The bus pins (driver outputs and receiver inputs) have extra protection structures, which have been tested up to ±15kV without damage. These structures withstand high ESD in all states: normal operation, in shutdown, and when powered off.

ESD protection is be tested in various ways. MaxLinear uses the following methods to qualify the protection structures designed into XR3160:

±8kV using IEC 61000-4-2 Contact Discharge

±15kV using IEC 61000-4-2 Airgap Discharge

±15kV using the Human Body Model (HBM)

The IEC 61000-4-2 standard is more rigorous than HBM, resulting in lower voltage levels compared with HBM for the same level of ESD protection. Because IEC 61000-4-2 specifies a lower series resistance, the peak current is higher than HBM. The XR3160 has passed both HBM and IEC 61000-4-2 testing without damage.

## TRUTH TABLES

**TABLE 1: RS-232 TX TRUTH TABLE**

| INPUTS | | | OUTPUTS |
|---|---|---|---|
| $\overline{\text{SHDN}}$ | RS-485/$\overline{\text{RS-232}}$ | DI/T1IN, DE/T2IN | Z(B)/T1OUT, Y(A)/T2OUT |
| 0 | X | X | 1/8th unit load |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | X | RS-485 Mode |

**TABLE 2: RS-232 RX TRUTH TABLE**

| INPUTS | | | OUTPUTS |
|---|---|---|---|
| $\overline{\text{SHDN}}$ | RS-485/$\overline{\text{RS-232}}$ | B/R1IN, A/R2IN | R1OUT, RO/R2OUT |
| X | 0 | 0 | 1 |
| X | 0 | 1 | 0 |
| X | 0 | Inputs open | 1 |
| X | 1 | X | R1OUT High-Z,<br>RO/R2OUT in RS-485 Mode |

**TABLE 3: RS-485/422 TX TRUTH TABLE**

| INPUTS | | | | OUTPUTS | |
|---|---|---|---|---|---|
| $\overline{\text{SHDN}}$ | RS-485/$\overline{\text{RS-232}}$ | DE/T2IN | DI/T1IN | Z(B)/T1OUT | Y(A)/T2OUT |
| 0 | X | X | X | 1/8th unit load | 1/8th unit load |
| 1 | 1 | 0 | X | 1/8th unit load | 1/8th unit load |
| 1 | 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 1 | 0 | 1 |
| X | 0 | X | X | RS-232 Mode | |

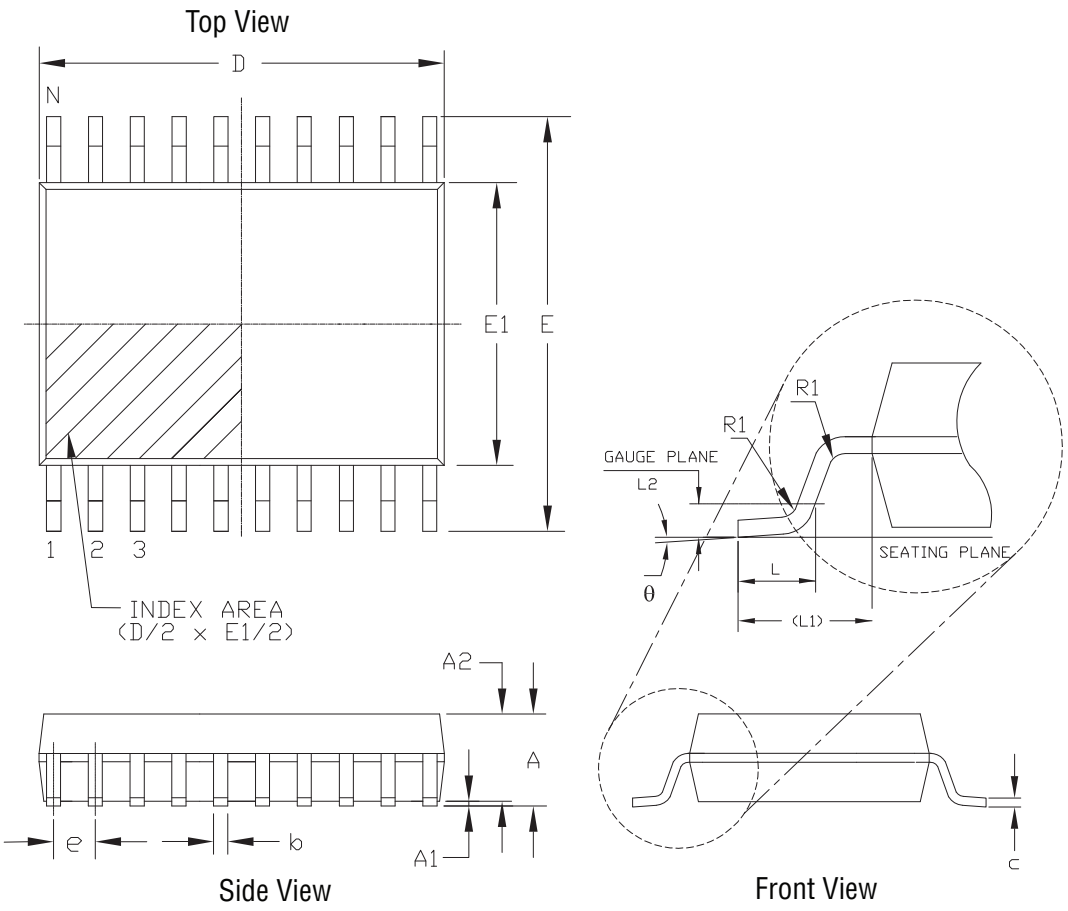
**TABLE 4: RS-485/422 RX TRUTH TABLE**

| INPUTS | | | | | OUTPUT |
|---|---|---|---|---|---|
| RS-485/$\overline{\text{RS-232}}$ | $\overline{\text{SHDN}}$ | HALF/$\overline{\text{FULL}}$ | (A-B) | (Y-Z) | RO/R2OUT |
| 1 | 0 | X | X | X | High-Z |
| 1 | 1 | 0 | ≥ -50mV | X | 1 |
| 1 | 1 | 0 | ≤ -200mV | X | 0 |
| 1 | 1 | 0 | Floating | X | 1 |
| 1 | 1 | 1 | X | ≥ -50mV | 1 |
| 1 | 1 | 1 | X | ≤ -200mV | 0 |
| 1 | 1 | 1 | X | Floating | 1 |
| 0 | X | X | X | X | RS-232 Mode |

* Y and Z correspond to pins 6 and 5. A and B correspond to pins 13 and 14.

## MECHANICAL DIMENSIONS

**FIGURE 12. SSOP 20**




| PACKAGE OUTLINE SSOP 5.3mm BODY JEDEC MO-150 VARIATION AE | | | | | | |
|---|---|---|---|---|---|---|
| SYMBOLS | COMMON DIMENSIONS IN MM (Control Unit) | | | COMMON DIMENSIONS IN INCH (Reference Unit) | | |
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | — | — | 2.00 | — | — | 0.079 |
| A1 | 0.05 | — | — | 0.002 | — | — |
| A2 | 1.65 | 1.75 | 1.85 | 0.065 | 0.069 | 0.073 |
| b | 0.22 | — | 0.38 | 0.009 | — | 0.015 |
| c | 0.09 | — | 0.25 | 0.004 | — | 0.010 |
| E | 7.40 | 7.80 | 8.20 | 0.291 | 0.307 | 0.323 |
| E1 | 5.00 | 5.30 | 5.60 | 0.197 | 0.209 | 0.220 |
| e | 0.65 BSC | | | 0.026 BSC | | |
| L | 0.55 | 0.75 | 0.95 | 0.022 | 0.030 | 0.037 |
| L1 | 1.25 REF | | | 0.049 REF | | |
| L2 | 0.25 BSC | | | 0.010 BSC | | |
| R1 | 0.09 | — | — | 0.004 | — | — |
| θ | 0° | 4° | 8° | 0° | 4° | 8° |
| D | 6.90 | 7.20 | 7.50 | .272 | 0.283 | 0.295 |
| N | 20 | | | | | |

Drawing No: POD-00000119
Revision: A

## REVISION HISTORY

| DATE | REVISION | DESCRIPTION |
|---|---|---|
| Sept 2013 | 1.0.0 | Production Release |
| Jan 2018 | 1.0.1 | Update to MaxLinear logo. Update format and Ordering Information. Moved ESD ratings on page 2. |

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