



# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

## General Description

The MAX3480A/MAX3480B are electrically isolated RS-485/RS-422 data-communications interfaces. Transceivers, optocouplers, and a transformer are all included in one low-cost, 28-pin DIP package. A single +3.3V supply on the logic side powers both sides of the interface.

The MAX3480B features reduced-slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free data transmission at data rates up to 250kbps. The MAX3480A's driver slew rate is not limited, allowing transmission rates up to 2.5Mbps.

These devices typically draw 180mA of quiescent supply current. The MAX3480B provides a low-power shutdown mode in which it consumes only 0.2 $\mu$ A.

Drivers are short-circuit current limited and are protected against excessive power dissipation by thermal shutdown circuitry that places the driver outputs into a high-impedance state. The receiver input has a fail-safe feature that guarantees a logic-high output if the input is open circuit.

The MAX3480A/MAX3480B typically withstand 1600V<sub>RMS</sub> (1 minute) or 2000V<sub>RMS</sub> (1 second). Their isolated inputs and outputs meet RS-485/RS-422 specifications.

## Applications

Isolated RS-485/RS-422 Data Interface  
Transceivers for EMI-Sensitive Applications  
Industrial-Control Local Area Networks  
Automatic Test Equipment  
HVAC/Building Control Networks

## Ordering Information

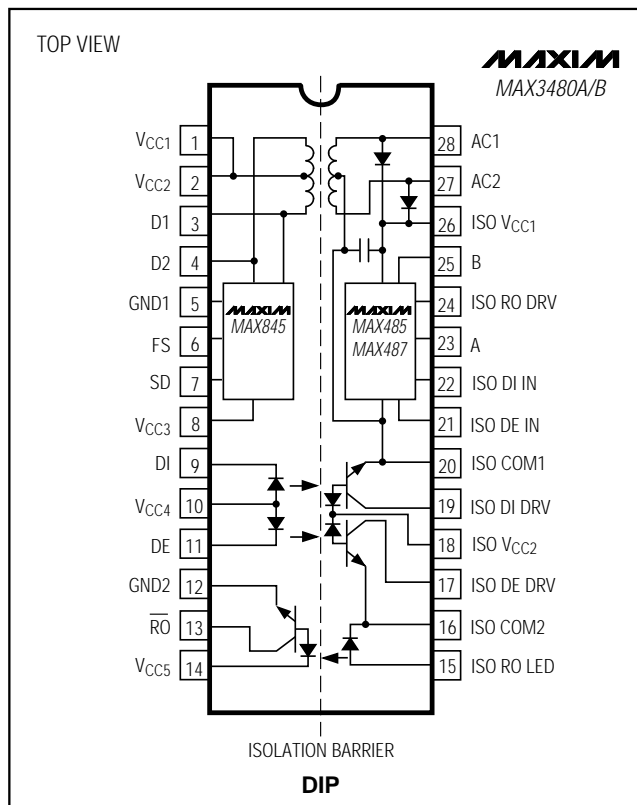
| PART        | TEMP. RANGE    | PIN-PACKAGE    | DATA RATE (kbps) |
|-------------|----------------|----------------|------------------|
| MAX3480ACPI | 0°C to +70°C   | 28 Plastic DIP | 2500             |
| MAX3480AEPI | -40°C to +85°C | 28 Plastic DIP | 2500             |
| MAX3480BCPI | 0°C to +70°C   | 28 Plastic DIP | 250              |
| MAX3480BEPI | -40°C to +85°C | 28 Plastic DIP | 250              |

## Features

- ◆ Isolated Data Interface to 1600V<sub>RMS</sub> (1 minute)
- ◆ Slew-Rate-Limited Data Transmission (MAX3480B)
- ◆ High-Speed, Isolated, 2.5Mbps RS-485 Interface (MAX3480A)
- ◆ -7V to +12V Common-Mode Input Voltage Range with Respect to Isolated Ground
- ◆ Single +3.3V Supply
- ◆ Current Limiting and Thermal Shutdown for Driver Overload Protection
- ◆ Standard 28-Pin DIP Package

MAX3480A/MAX3480B

## Pin Configuration



# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

## ABSOLUTE MAXIMUM RATINGS

With Respect to GND:

Supply Voltage (VCC1, VCC2, VCC4, VCC5) .....-0.3V to +3.8V  
 Supply Voltage (VCC3) .....-0.3V to +7V  
 Control Input Voltage (SD, FS) .....-0.3V to (VCC + 0.3V)  
 Receiver Output Voltage (RO).....-0.3V to (VCC + 0.3V)

With Respect to ISO COM:

Control Input Voltage (ISO DE  $\bar{}$ ) .....-0.3V to (ISO VCC + 0.3V)  
 Driver Input Voltage (ISO DI  $\bar{}$ ).....-0.3V to (ISO VCC + 0.3V)  
 Receiver Output Voltage (ISO RO  $\bar{}$ ) .....-0.3V to (ISO VCC + 0.3V)  
 Driver Output Voltage (A, B).....-8V to +12.5V  
 Receiver Input Voltage (A, B).....-8V to +12.5V

LED Forward Current (DI, DE, ISO RO LED) .....50mA  
 Continuous Power Dissipation (TA = +70°C)  
   Plastic DIP (derate 9.09mW/°C above +70°C) .....727mW  
 Operating Temperature Ranges  
   MAX3480\_CPI .....0°C to +70°C  
   MAX3480\_EPI .....-40°C to +85°C  
 Storage Temperature Range .....-65°C to +160°C  
 Lead Temperature (soldering, 10sec) .....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

(VCC = VCC1 = VCC2 = VCC4 = VCC5 = 3.0V to 3.6V, FS = 0V, TA = TMIN to TMAX, unless otherwise noted. Typical values are at VCC = VCC1 = VCC2 = VCC4 = VCC5 = 3.3V and TA = +25°C.) (Notes 1, 2, 3)

| PARAMETER  | SYMBOL | CONDITIONS                     |              | MIN       | TYP    | MAX | UNITS |
|--|--------|--------------------------------|--------------|-----------|--------|-----|-------|
| Supply Voltage   | VS     |                                |              | 3.0       | 3.3    | 3.6 | V     |
| Switch Frequency   | fSWL   | FS = 0V                        |              | 600       |        |     | kHz   |
|  | fSWH   | FS = VCC or open               |              | 900       |        |     |       |
| Operating Supply Current   | ICC    | MAX3480A,<br>DE' = VCC or open | RL = ∞       | 180       | 260    | mA  |       |
|  |        |                                | RL = 54Ω     | 280       |        |     |       |
|  |        | MAX3480B,<br>DE' = VCC or open | RL = ∞       | 120       | 200    |     |       |
|  |        |                                | RL = 54Ω     | 240       |        |     |       |
| Shutdown Supply Current (Note 3)   | ISHDN  | SD = VCC3                      |              | 0.2       |        | μA  |       |
| FS Input Threshold   | VFSH   | High                           |              | 2.4       |        | V   |       |
|  | VFSL   | Low                            |              | 0.8       |        |     |       |
| FS Input Pull-Up Current   | IFSL   | FS low                         |              | 50        |        | μA  |       |
| FS Input Leakage Current   | IFSM   | FS high                        |              | 10        |        | pA  |       |
| Input High Voltage   | VIH    | DE', DI' (Figure 1)            |              | VCC - 0.4 |        | V   |       |
| Input Low Voltage  | VIL    | DE', DI' (Figure 1)            |              | 0.4       |        | V   |       |
| Isolation Resistance   | RISO   | TA = +25°C, VISO = 50VDC       |              | 100       | 10,000 | MΩ  |       |
| Isolation Capacitance  | CISO   | TA = +25°C, VISO = 50VDC       |              | 10        |        | pF  |       |
| Differential Driver Output (no load)   | VOD1   |                                |              | 8         |        | V   |       |
| Differential Driver Output (with load)                                       | VOD2   | R = 50Ω (RS-422)               |              | 2         |        | V   |       |
|  |        | R = 27Ω (RS-485), Figure 3     |              | 1.5       |        |     | 5     |
| Change in Magnitude of Driver Output Voltage for Complementary Output States | ΔVOD   | R = 27Ω or 50Ω,<br>Figure 3    | Differential | 0.3       |        | V   |       |
|  |        |                                | Common Mode  | 0.3       |        |     |       |
| Driver Common-Mode Output  | VOC    | R = 27Ω or 50Ω, Figure 4       |              | 4         |        | V   |       |

# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

MAX3480A/MAX3480B

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{CC} = V_{CC1} = V_{CC2} = V_{CC4} = V_{CC5} = 3.0V$  to  $3.6V$ ,  $F_S = 0V$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $V_{CC} = V_{CC1} = V_{CC2} = V_{CC4} = V_{CC5} = 3.3V$  and  $T_A = +25^{\circ}C$ .) (Notes 1, 2, 3)

| PARAMETER                                    | SYMBOL          | CONDITIONS                              | MIN            | TYP            | MAX        | UNITS   |
|--|-----------------|---|----------------|----------------|------------|---------|
| Input Current (A, B)                         | ISO $I_{IN}$    | $DE' = 0V$ ,<br>$V_{CC} = 0V$ or $3.6V$ | MAX3480A       | $V_{IN} = 12V$ | 1.0        | mA      |
|  |                 |   |                | $V_{IN} = -7V$ | -0.8       |         |
|  |                 | MAX3480B                                | $V_{IN} = 12V$ | 0.25           |            |         |
|  |                 |   | $V_{IN} = -7V$ | -0.2           |            |         |
| Receiver Input Resistance                    | $R_{IN}$        | $-7V \leq V_{CM} \leq 12V$              | MAX3480A       | 12             | k $\Omega$ |         |
|  |                 |   | MAX3480B       | 48             |            |         |
| Receiver Differential Threshold              | $V_{TH}$        | $-7V \leq V_{CM} \leq 12V$              | -0.2           |                | 0.2        | V       |
| Receiver Input Hysteresis                    | $\Delta V_{TH}$ | $V_{CM} = 0V$                           |                | 70             |            | mV      |
| Receiver Output/Receiver Output Low Voltage  | $V_{OL}$        | $DI' = V_{CC}$                          |                |                | 0.4        | V       |
| Receiver Output/Receiver Output High Current | $I_{OH}$        | $V_{OUT} = 3.6V$ , $DI' = 0V$           |                |                | 250        | $\mu A$ |
| Driver Short-Circuit Current                 | ISO $I_{OSD}$   | $-7V \leq V_O \leq 12V$ (Note 4)        |                | 100            |            | mA      |

## SWITCHING CHARACTERISTICS—MAX3480A

( $V_{CC} = V_{CC1} = V_{CC2} = V_{CC4} = V_{CC5} = 3.0V$  to  $3.6V$ ,  $F_S = 0V$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $V_{CC} = V_{CC1} = V_{CC2} = V_{CC4} = V_{CC5} = 3.3V$  and  $T_A = +25^{\circ}C$ .)

| PARAMETER  | SYMBOL     | CONDITIONS   | MIN | TYP | MAX | UNITS   |
|--|------------|--|-----|-----|-----|---------|
| Driver Input to Output Propagation Delay         | $t_{PLH}$  | Figures 4, 6; $R_{DIFF} = 54\Omega$ ,<br>$C_{L1} = C_{L2} = 100pF$ |     | 100 | 275 | ns      |
|  | $t_{PHL}$  |  |     | 100 | 275 |         |
| Driver Output Skew (Note 5)                      | $t_{SKEW}$ | Figures 4, 6; $R_{DIFF} = 54\Omega$ ,<br>$C_{L1} = C_{L2} = 100pF$ |     | 25  | 90  | ns      |
| Driver Rise or Fall Time                         | $t_R, t_F$ | Figures 4, 6; $R_{DIFF} = 54\Omega$ ,<br>$C_{L1} = C_{L2} = 100pF$ |     | 15  | 40  | ns      |
| Driver Enable to Output High                     | $t_{ZH}$   | Figures 5, 7; $C_L = 100pF$ , S2 closed                            |     | 0.2 | 1.5 | $\mu s$ |
| Driver Enable to Output Low                      | $t_{ZL}$   | Figures 5, 7; $C_L = 100pF$ , S1 closed                            |     | 0.2 | 1.5 | $\mu s$ |
| Driver Disable Time from High                    | $t_{HZ}$   | Figures 5, 7; $C_L = 15pF$ , S2 closed                             |     | 0.3 | 1.5 | $\mu s$ |
| Driver Disable Time from Low                     | $t_{LZ}$   | Figures 5, 7; $C_L = 15pF$ , S1 closed                             |     | 0.3 | 1.5 | $\mu s$ |
| Receiver Input to Output Propagation Delay       | $t_{PLH}$  | Figures 4, 8; $R_{DIFF} = 54\Omega$ ,<br>$C_{L1} = C_{L2} = 100pF$ |     | 100 | 225 | ns      |
|  | $t_{PHL}$  |  |     | 100 | 225 |         |
| $ t_{PLH} - t_{PHL} $ Differential Receiver Skew | $t_{SKD}$  | Figures 4, 8; $R_{DIFF} = 54\Omega$ ,<br>$C_{L1} = C_{L2} = 100pF$ |     | 20  |     | ns      |
| Maximum Data Rate                                | $f_{MAX}$  | $t_{PLH}, t_{PHL} < 50\%$ of data period                           | 2.5 |     |     | Mbps    |

# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

MAX3480A/MAX3480B

## SWITCHING CHARACTERISTICS—MAX3480B

( $V_{CC} = V_{CC1} = V_{CC2} = V_{CC4} = V_{CC5} = 3.0V$  to  $3.6V$ ,  $F_S = 0V$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $V_{CC} = V_{CC1} = V_{CC2} = V_{CC4} = V_{CC5} = 3.3V$  and  $T_A = +25^{\circ}C$ .)

| PARAMETER  | SYMBOL     | CONDITIONS   | MIN  | TYP | MAX | UNITS   |
|--|------------|--|------|-----|-----|---------|
| Driver Input to Output Propagation Delay         | $t_{PLH}$  | Figures 4, 6; $R_{DIFF} = 54\Omega$ ,<br>$C_{L1} = C_{L2} = 100pF$ |      | 1.0 | 2.0 | $\mu s$ |
|  | $t_{PHL}$  |  |      | 1.0 | 2.0 |         |
| Driver Output Skew                               | $t_{SKEW}$ | Figures 4, 6; $R_{DIFF} = 54\Omega$ ,<br>$C_{L1} = C_{L2} = 100pF$ |      | 100 | 800 | ns      |
| Driver Rise or Fall Time                         | $t_R, t_F$ | Figures 4, 6; $R_{DIFF} = 54\Omega$ ,<br>$C_{L1} = C_{L2} = 100pF$ |      | 1.0 | 2.0 | $\mu s$ |
| Driver Enable to Output High                     | $t_{ZH}$   | Figures 5, 7; $C_L = 100pF$ , S2 closed                            |      | 50  | 100 | $\mu s$ |
| Driver Enable to Output Low                      | $t_{ZL}$   | Figures 5, 7; $C_L = 100pF$ , S1 closed                            |      | 50  | 100 | $\mu s$ |
| Driver Disable Time from Low                     | $t_{LZ}$   | Figures 5, 7; $C_L = 15pF$ , S1 closed                             |      | 13  | 50  | $\mu s$ |
| Driver Disable Time from High                    | $t_{HZ}$   | Figures 5, 7; $C_L = 15pF$ , S2 closed                             |      | 13  | 50  | $\mu s$ |
| Receiver Input to Output Propagation Delay       | $t_{PLH}$  | Figures 4, 8; $R_{DIFF} = 54\Omega$ ,<br>$C_{L1} = C_{L2} = 100pF$ |      | 0.8 | 2.0 | $\mu s$ |
|  | $t_{PHL}$  |  |      | 0.8 | 2.0 |         |
| $ t_{PLH} - t_{PHL} $ Differential Receiver Skew | $t_{SKD}$  | Figures 4, 8; $R_{DIFF} = 54\Omega$ ,<br>$C_{L1} = C_{L2} = 100pF$ |      | 50  |     | ns      |
| Maximum Data Rate                                | $f_{MAX}$  | $t_{PLH}, t_{PHL} < 50\%$ of data period                           | 0.25 |     |     | Mbps    |

**Note 1:** All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to logic-side ground (GND1, GND2), unless otherwise specified.

**Note 2:** For DE' and DI' pin descriptions, see *Detailed Block Diagram* and *Typical Application Circuit* (Figure 1 for MAX3480A/MAX3480B).

**Note 3:** Shutdown supply current is the current at  $V_{CC1}$  when shutdown is enabled.

**Note 4:** Applies to peak current. See *Typical Operating Characteristics* and *Applications Information*.

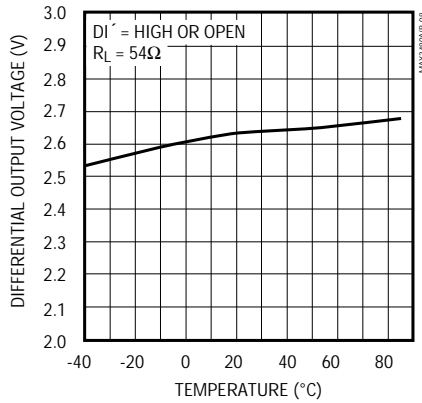
# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

## Typical Operating Characteristics

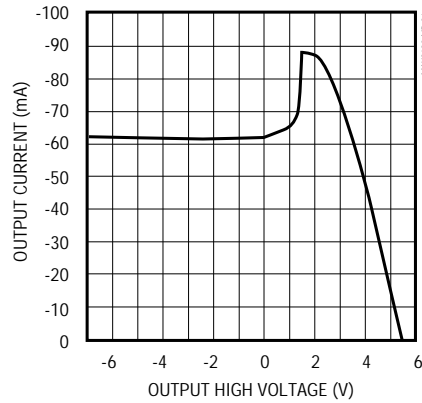
( $V_{CC-} = 3.3V$ ,  $T_A = +25^{\circ}C$ , unless otherwise noted.)

MAX3480A/MAX3480B

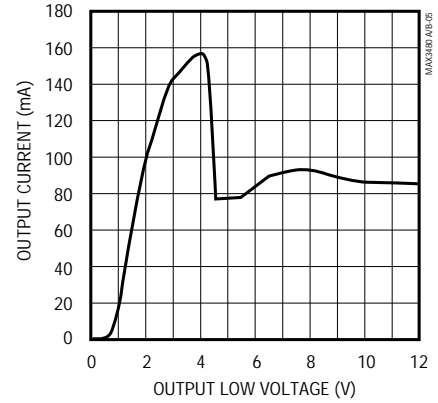
**DRIVER DIFFERENTIAL OUTPUT VOLTAGE vs. TEMPERATURE**



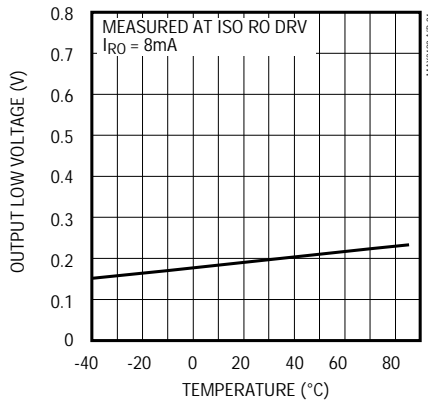
**OUTPUT CURRENT vs. DRIVER OUTPUT HIGH VOLTAGE**



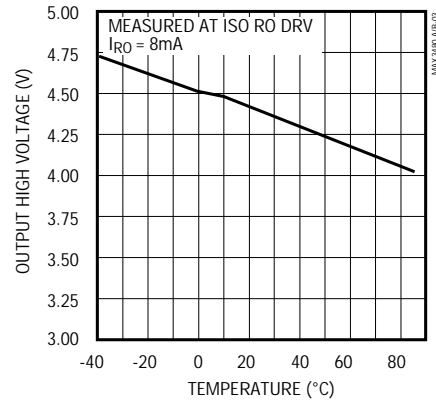
**OUTPUT CURRENT vs. DRIVER OUTPUT LOW VOLTAGE**



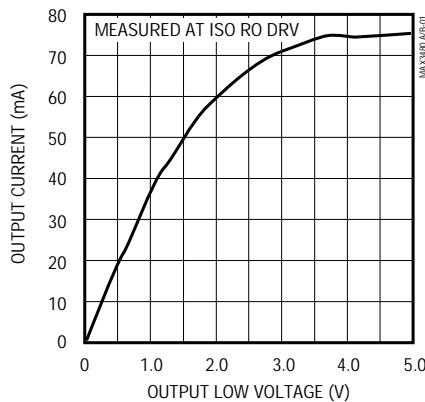
**RECEIVER OUTPUT LOW VOLTAGE vs. TEMPERATURE**



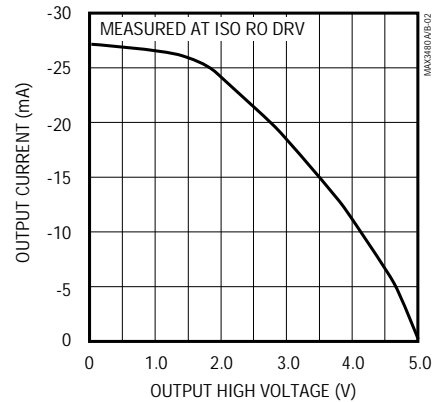
**RECEIVER OUTPUT HIGH VOLTAGE vs. TEMPERATURE**



**OUTPUT CURRENT vs. RECEIVER OUTPUT LOW VOLTAGE**



**OUTPUT CURRENT vs. RECEIVER OUTPUT HIGH VOLTAGE**

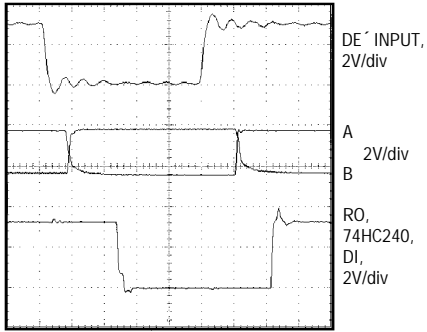


# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

## Typical Operating Characteristics (continued)

( $V_{CC} = 3.3V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

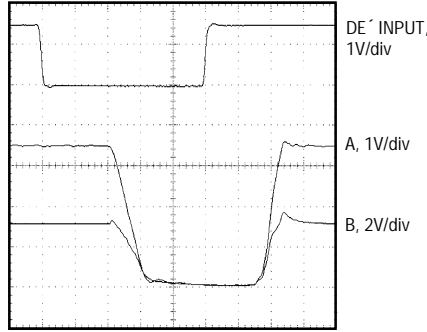
**MAX3480A DRIVER INPUT (AB) AND RECEIVER OUTPUT (RO)**



100ns/div

CIRCUIT OF FIGURE 2, TERMINATION: 100Ω

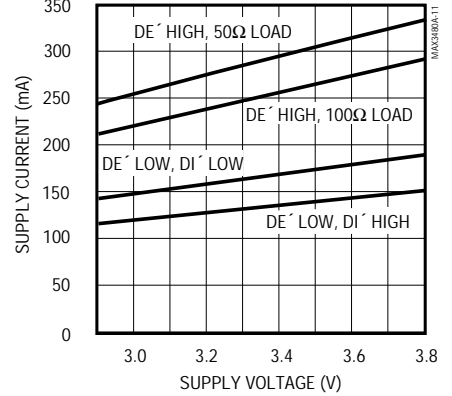
**MAX3480A DRIVER ENABLE (AB) AND RECEIVER OUTPUT (RO)**



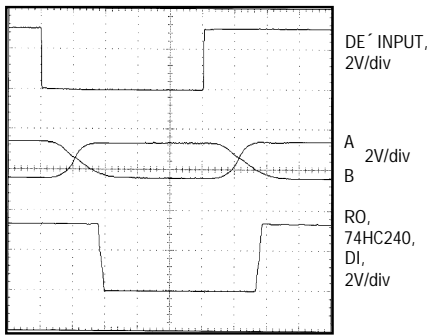
100ns/div

CIRCUIT OF FIGURE 2, TERMINATION: 100Ω

**MAX3480A SUPPLY CURRENT vs. SUPPLY VOLTAGE**



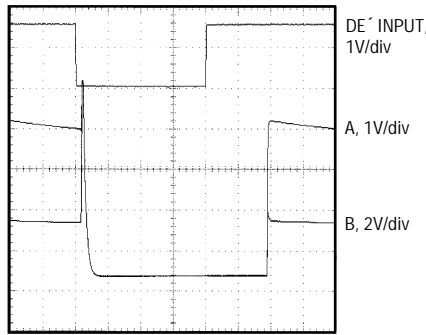
**MAX3480B DRIVER INPUT (AB) AND RECEIVER OUTPUT (RO)**



1μs/div

CIRCUIT OF FIGURE 2, TERMINATION: 100Ω

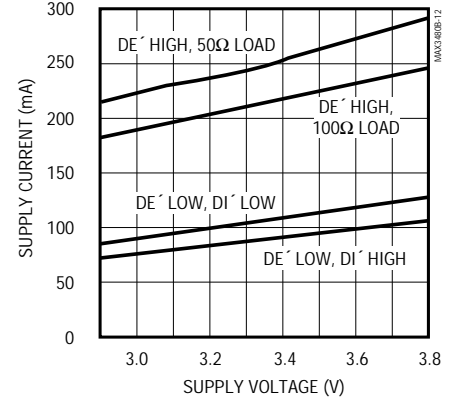
**MAX3480B DRIVER ENABLE (AB) AND RECEIVER OUTPUT (RO)**



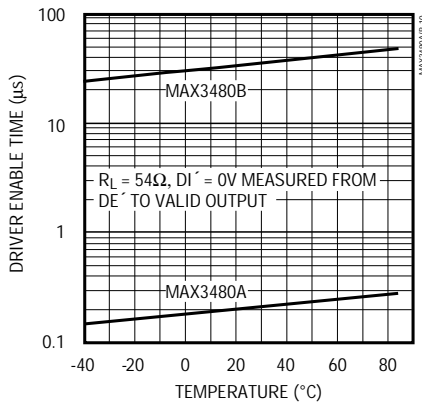
25μs/div

CIRCUIT OF FIGURE 2, TERMINATION: 100Ω

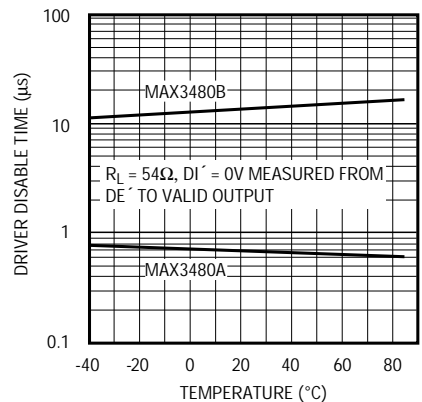
**MAX3480B SUPPLY CURRENT vs. SUPPLY VOLTAGE**



**DRIVER ENABLE TIME vs. TEMPERATURE**



**DRIVER DISABLE TIME vs. TEMPERATURE**



# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

## Pin Description

| PIN                                  | NAME             | FUNCTION   |
|--------------------------------------|------------------|--|
| <b>PINS ON THE NON-ISOLATED SIDE</b> |                  |  |
| 1                                    | V <sub>CC1</sub> | Logic-Side (non-isolated side) +3.3V Supply Voltage Input. Connect to pins 2, 10, and 14.  |
| 2                                    | V <sub>CC2</sub> | Logic-Side (non-isolated side) +3.3V Supply Voltage Input. Connect to pins 1, 10, and 14.  |
| 3, 4                                 | D1, D2           | Boost-Voltage Generator Outputs. See Figures 1 and 2.  |
| 5, 12                                | GND1,<br>GND2    | Logic-Side Ground Inputs. Must be connected; not internally connected.   |
| 6                                    | FS               | Frequency Switch Input. If FS = V <sub>CC</sub> , switch frequency is high; if FS = 0V, switch frequency is low (normal connection).   |
| 7                                    | SD               | Power-Supply Shutdown Input. Must be connected to logic ground.  |
| 8                                    | V <sub>CC3</sub> | Boosted V+ Voltage Input. Must be connected as shown in Figures 1 and 2.   |
| 9                                    | DI               | Driver Input. With DE' high, a low on DI' forces output A low and output B high. Similarly, a high on DI' forces output A high and output B low. Drives internal LED cathode through R1 (Table 1 of Figure 2).   |
| 10                                   | V <sub>CC4</sub> | Logic-Side (non-isolated side) +3.3V Supply Voltage Input. Connect to pins 1, 2, and 14.   |
| 11                                   | DE               | Driver-Enable Input. The driver outputs, A and B, are enabled by bringing DE' high. The driver outputs are high impedance when DE' is low. If the driver outputs are enabled, the device functions as a line driver. While the driver outputs are high impedance, the device functions as a line receiver. Drives internal LED cathode through R2 (Table 1 of Figure 2). |
| 13                                   | $\overline{RO}$  | Receiver Output. If A > B by 200mV, $\overline{RO}$ will be low; if A < B by 200mV, $\overline{RO}$ will be high. Open collector; must have pull-up (R3) to V <sub>CC</sub> (Table 1 of Figure 2).   |
| 14                                   | V <sub>CC5</sub> | Logic-Side (non-isolated side) +3.3V Supply Voltage Input. Connect to pins 1, 2, and 10.   |

MAX3480A/MAX3480B

# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

## Pin Description (continued)

| PIN  | NAME                 | FUNCTION   |
|--|----------------------|--|
| <b>PINS ON THE ISOLATED RS-485/RS-422 SIDE</b> |                      |  |
| 15   | ISO RO LED           | Isolated Receiver-Output LED Anode (input). If $A > B$ by 200mV, ISO RO LED will be high; if $A < B$ by 200mV, ISO RO LED will be low.   |
| 16   | ISO COM2             | Isolated-Supply Common Input. Connect to ISO COM1.   |
| 17   | ISO DE DRV           | Isolated Driver-Enable Drive Input. The driver outputs, A and B, are enabled by bringing DE $\bar{}$ high. The driver outputs are high impedance when DE $\bar{}$ is low. If the driver outputs are enabled, the device functions as a line driver. While the driver outputs are high impedance, the device functions as a line receiver. Open collector output; must have pull-up (R4) to ISO V <sub>CC</sub> and be connected to ISO DE IN for normal operation (Table 1 of Figure 2). |
| 18   | ISO V <sub>CC2</sub> | Isolated-Supply Positive Input Voltage. Connect to ISO V <sub>CC1</sub> .  |
| 19   | ISO DI DRV           | Isolated Driver-Input Drive. With DE $\bar{}$ high, a low on DI $\bar{}$ forces output A low and output B high. Similarly, a high on DI $\bar{}$ forces output A high and output B low. Open-collector output; must have pull-up (R5) to ISO V <sub>CC</sub> and be connected to ISO DI IN for normal operation (Table 1 of Figure 2).   |
| 20   | ISO COM1             | Isolated-Supply Common Output. Connect to ISO COM2. If RS-485 wires have a shield, connect ISO COM1 to shield via 100 $\Omega$ resistor.   |
| 21   | ISO DE IN            | Isolated Driver-Enable Input. Connect to ISO DE DRV for normal operation.  |
| 22   | ISO DI IN            | Isolated Driver Input. Connect to ISO DI DRV for normal operation.   |
| 23   | A                    | Noninverting Driver Output and Noninverting Receiver Input.  |
| 24   | ISO RO DRV           | Isolated Receiver-Output Drive. Connect to ISO RO LED through R6 (Table 1 of Figure 2).  |
| 25   | B                    | Inverting Driver Output and Inverting Receiver Input   |
| 26   | ISO V <sub>CC1</sub> | Isolated Supply Positive Output Voltage. Connect to ISO V <sub>CC2</sub> .   |
| 27, 28   | AC2, AC1             | Internal Connections. Leave these pins unconnected.  |

**Note:** For DE $\bar{}$  and DI $\bar{}$  pin descriptions, see *Detailed Block Diagram* and *Typical Application Circuit*.



# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

MAX3480A/MAX3480B

## Detailed Description

The MAX3480A/MAX3480B are electrically isolated, RS-485/RS-422 data-communications interface solutions. Transceivers, optocouplers, a power driver, and a transformer are in one standard 28-pin DIP package. Signals and power are internally transported across the isolation barrier (Figure 1). Power is transferred from the logic side (non-isolated side) to the isolated side of the barrier through a center-tapped transformer. Signals cross the barrier through high-speed optocouplers. A single +3.3V supply on the logic side powers both sides of the interface.

The MAX3480B features reduced-slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free transmission at data rates up to 250kbps. The MAX3480A's driver slew rates are not limited, allowing transmission rates up to 2.5Mbps.

The frequency-select FS is connected to GND<sub>1</sub> in normal operation, which selects a switching frequency of approximately 600kHz. Connect to high for a higher 900kHz switching frequency.

Drivers are short-circuit current limited and are protected against excessive power dissipation by thermal

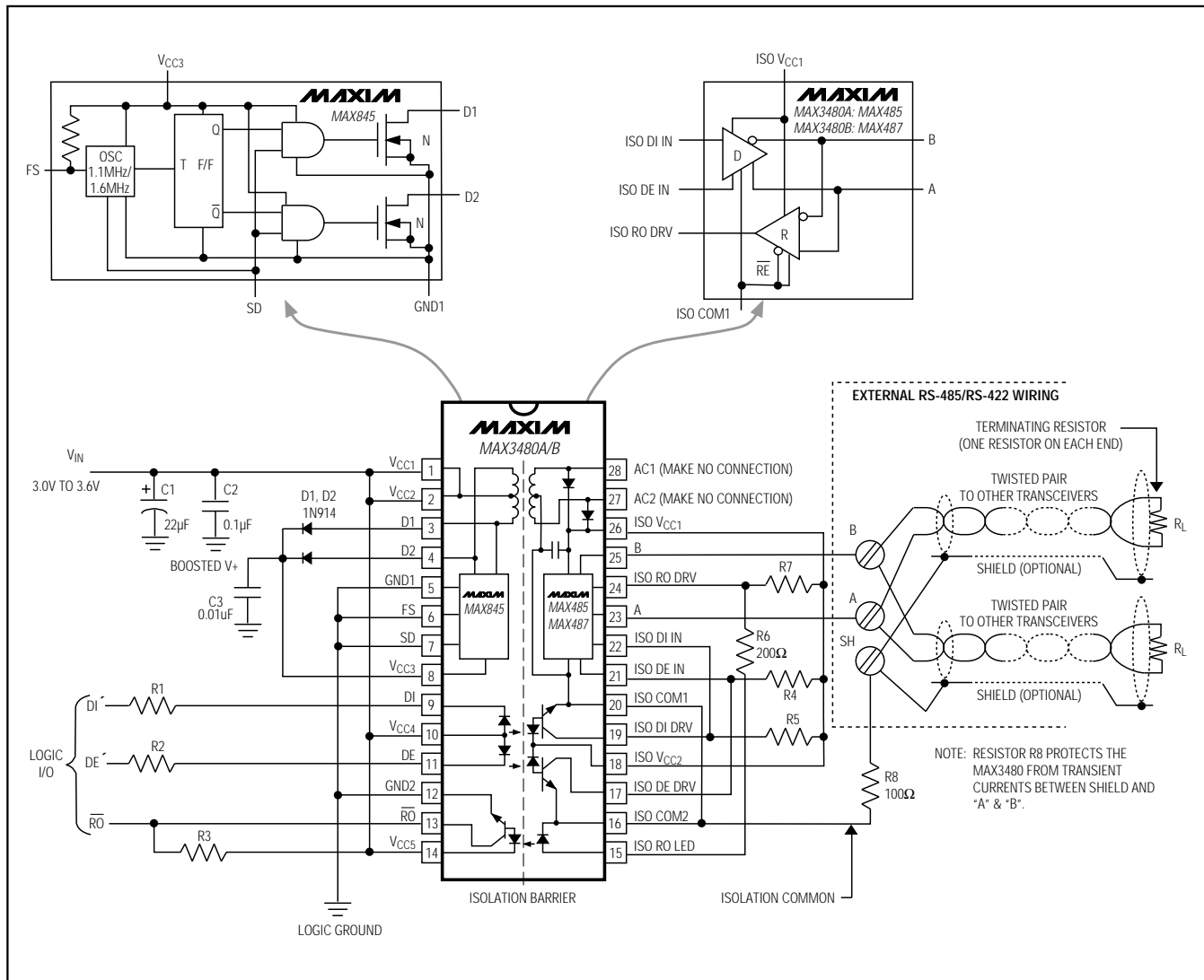


Figure 1. Detailed Block Diagram



# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

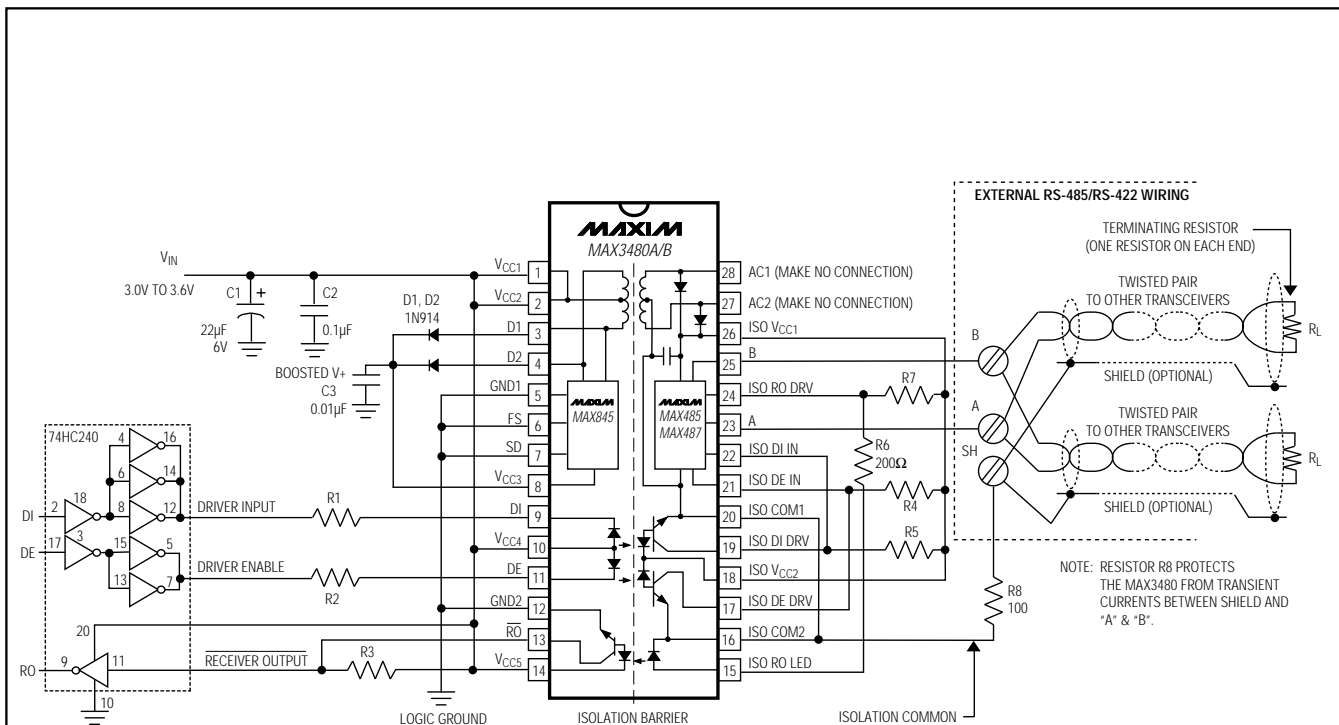
shutdown circuitry that puts the driver outputs into a high-impedance state. The receiver input has a fail-safe feature that guarantees a logic-high output if the input is open circuit.

The driver outputs are enabled by bringing DE high. Driver-enable times are typically 200ns for the MAX3480A and 50µs for the MAX3480B. Allow time for the devices to be enabled before sending data. When enabled, driver outputs function as line drivers. Driver outputs are high impedance when DE is low. While outputs are high impedance, they function as line receivers.

The MAX3480A/MAX3480B typically withstand 1600V<sub>RMS</sub> (1 minute) or 2000V<sub>RMS</sub> (1 second). The isolated outputs of these devices meet all RS-485/RS-422 specifications. The logic inputs can be driven from any TTL/CMOS-logic family with a series resistor, and the received data output can directly drive any of the TTL/CMOS-logic families with only a resistive pull-up.

### Boost Voltage

The MAX3480 requires external diodes on the primary of the transformer to develop the boost voltage for the power oscillator. In normal operation, whenever one of the oscillator outputs (D1 and D2) goes low, the other



**Table 1. Pull-Up and LED Drive Resistors**

| PART     | R1 (Ω) | R2 (Ω) | R3 (Ω) | R4 (Ω) | R5 (Ω) | R6 (Ω) | R7 (Ω) |
|----------|--------|--------|--------|--------|--------|--------|--------|
| MAX3480A | 150    | 130    | 680    | 3000   | 1000   | 200    | Open   |
| MAX3480B | 130    | 330    | 2000   | 2200   | 3000   | 200    | 470    |

Figure 2. Typical Application Circuit

# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

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## Test Circuits

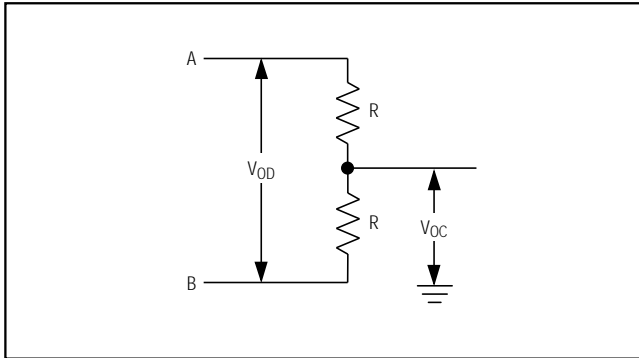


Figure 3. Driver DC Test Load

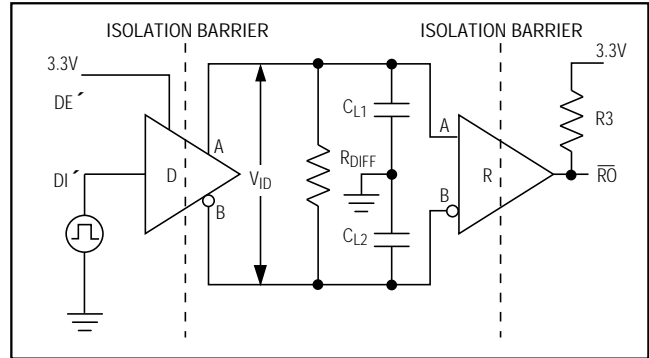


Figure 4. Driver/Receiver Timing Test Circuit

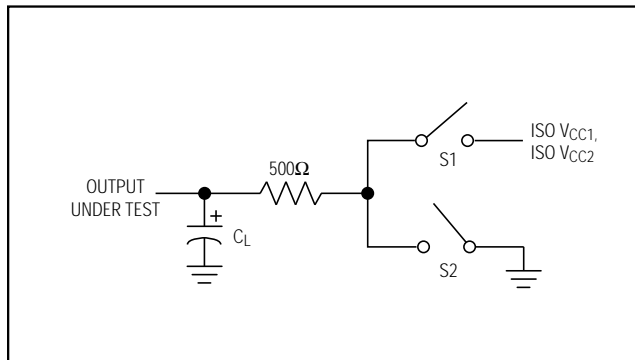


Figure 5. Driver Timing Test Load

## Switching Waveforms

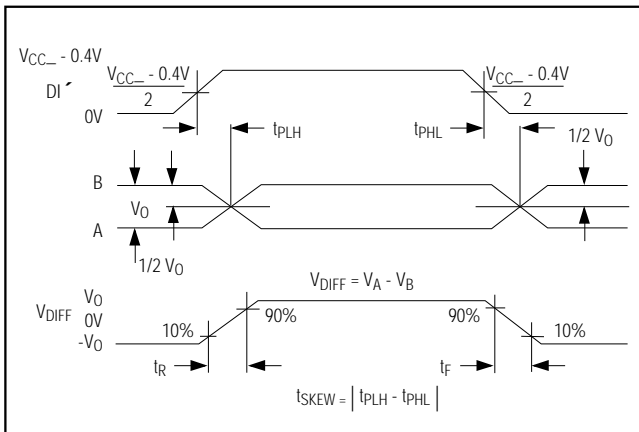


Figure 6. Driver Propagation Delays and Transition Times

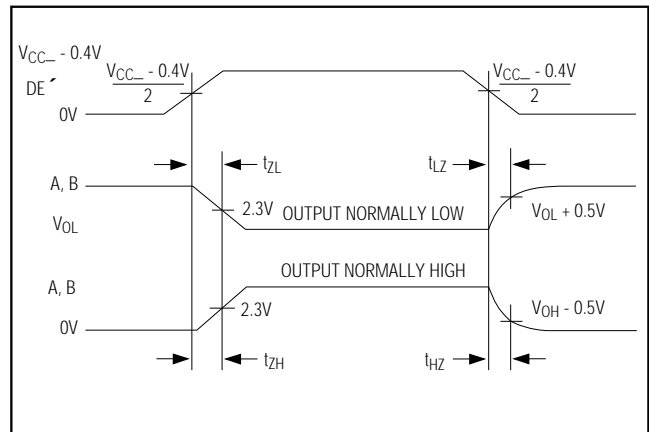


Figure 7. Driver Enable and Disable Times

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## Switching Waveforms (continued)

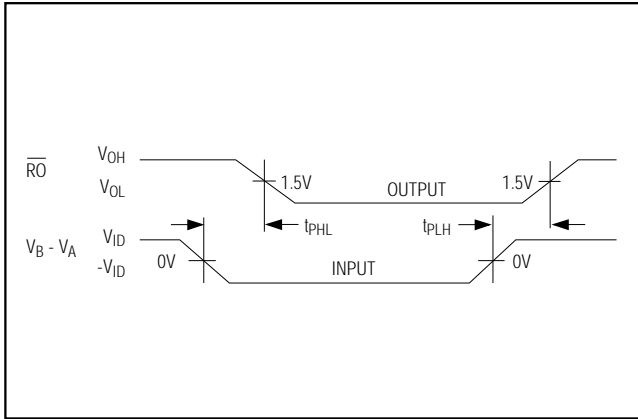


Figure 8. Receiver Propagation Delays

## Function Tables

**Table 2. Transmitting**

| INPUTS          |                 | OUTPUTS |        |
|-----------------|-----------------|---------|--------|
| DE <sup>̄</sup> | DI <sup>̄</sup> | B       | A      |
| 1               | 1               | 0       | 1      |
| 1               | 0               | 1       | 0      |
| 0               | X               | High-Z  | High-Z |

X = Don't care  
High-Z = High impedance

**Table 3. Receiving**

| INPUTS          |             | OUTPUT          |
|-----------------|-------------|-----------------|
| DE <sup>̄</sup> | A-B         | RO <sup>̄</sup> |
| 0               | ≥ +0.2V     | 0               |
| 0               | ≤ -0.2V     | 1               |
| 0               | Inputs open | 0               |

goes to approximately double the supply voltage. Since the circuit is symmetrical, the two outputs can be combined with diodes, filtered, and used to power the oscillator itself.

The diodes on the primary side may be any fast-switching, small-signal diodes, such as the 1N914, 1N4148, or CMPD2838. The nominal value of the primary filter capacitor C3 is 0.01μF.

### Driver Output Protection

There are two mechanisms to prevent excessive output current and power dissipation caused by faults or by bus contention. A foldback current limit on the output stage provides immediate protection against short circuits over the whole common-mode voltage range (see *Typical Operating Characteristics*). In addition, a thermal shutdown circuit forces the driver outputs into a high-impedance state if the die temperature rises excessively.

Resistor R8 provides additional protection by current limiting between the shield and the two signal wires. In the event that shielded cable is used and an external voltage or transient is inadvertently applied between the shield and the signal wires, the MAX3480 can be damaged. Although unlikely, this condition can occur during installation.

**The MAX3480 provides electrical isolation between logic ground and signal paths; it does not provide isolation from external shields and the signal paths. When in doubt, do not connect the shield. The MAX3480 can be damaged if resistor R8 is shorted out.**

# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

MAX3480A/MAX3480B

## Applications Information

The MAX3480A/MAX3480B are designed for bidirectional data communications on multipoint bus-transmission lines. Figure 9 shows a typical network application circuit. To minimize reflections, terminate the line at both ends with its characteristic impedance, and keep stub lengths off the main line as short as possible. The slew-rate-limited MAX3480B is more tolerant of imperfect termination and stubs off the main line.

The MAX3480A/MAX3480B are specified and characterized using the resistor values shown in Table 1 of Figure 2. Altering the recommended values can degrade performance.

The DI and DE inputs are the cathodes of LEDs whose anodes are connected to  $V_{CC}$ . These points are best driven by a 3.3V CMOS-logic gate with a series resistor to limit the current. The resistor values shown in Table 1 are recommended when the 74HC240 gate or equivalent is used. These values may need to be adjusted if a driving gate with dissimilar series resistance is used. DI and DE are intended to be driven through a series current-limiting resistor. Directly grounding these pins destroys the device.

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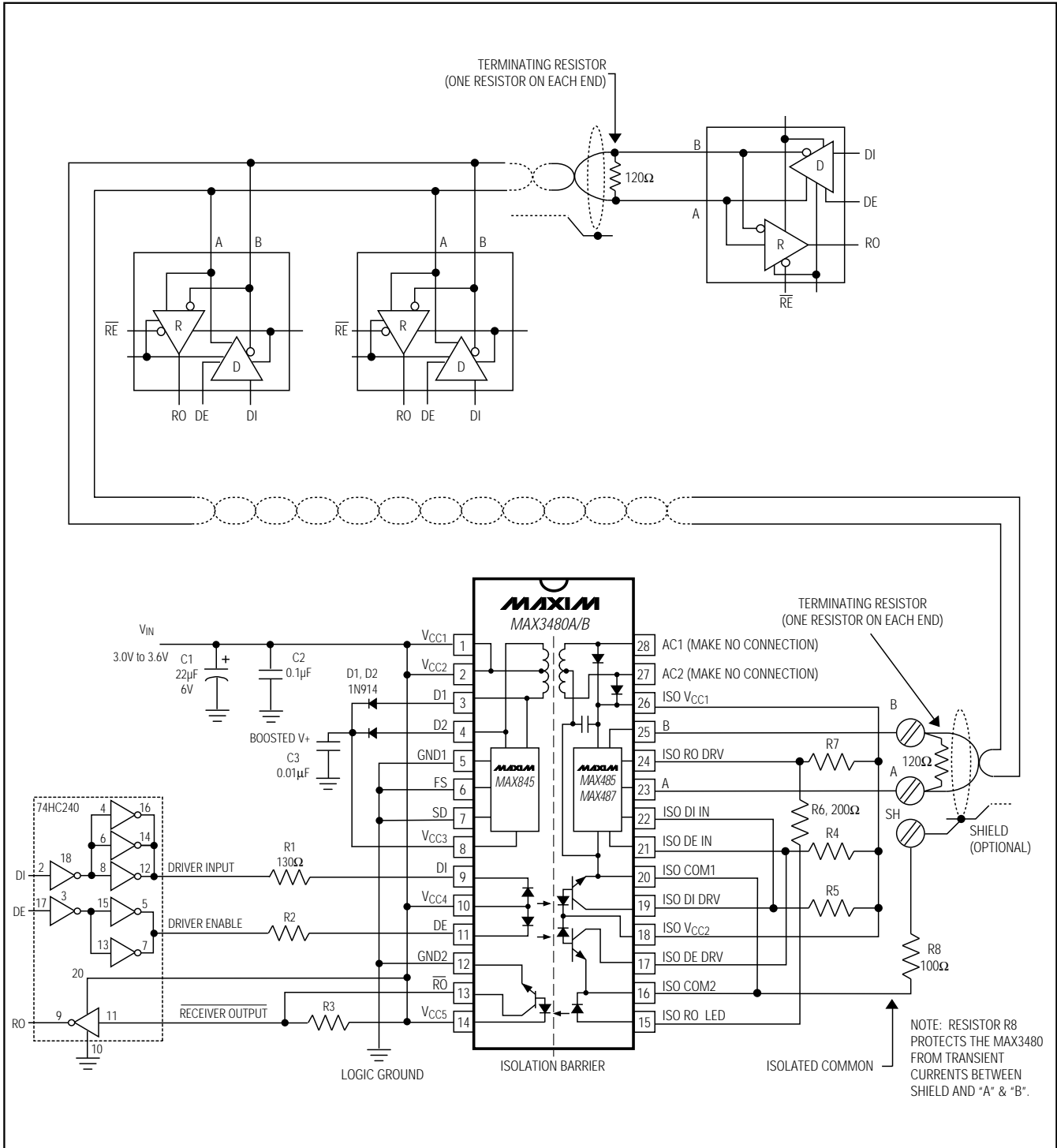


Figure 9. Typical RS-485/RS-422 Network

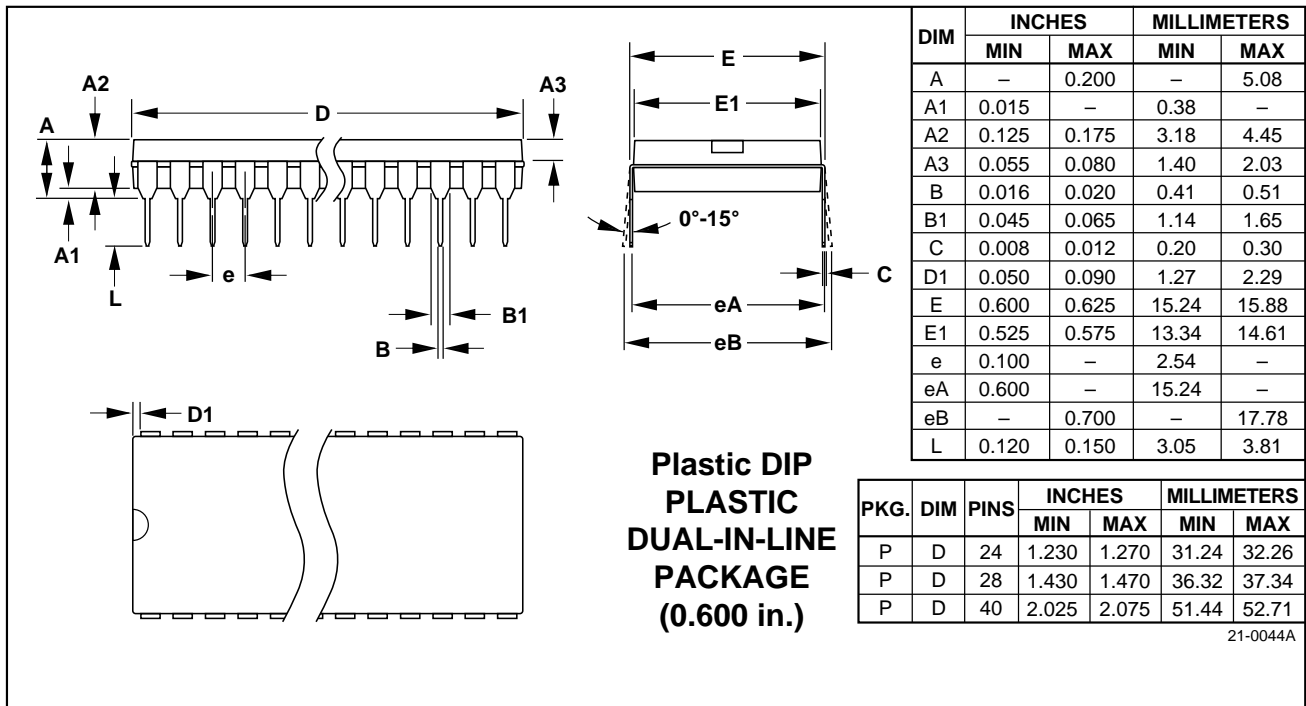
# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

MAX3480A/MAX3480B

**Table 4. Maxim's Isolated RS-485 Product Family**

| PART     | No. OF Tx/Rx | GUARANTEED DATA RATE (Mbps) | FULL/HALF DUPLEX | SLEW-RATE LIMITED | No. OF Tx/Rx ON BUS | SUPPLY VOLTAGE (V) |
|----------|--------------|-----------------------------|------------------|-------------------|---------------------|--------------------|
| MAX1480A | 1/1          | 2.50                        | Half             | No                | 32                  | 5.0                |
| MAX1480B | 1/1          | 0.25                        | Half             | Yes               | 32                  | 5.0                |
| MAX1490A | 1/1          | 2.50                        | Full             | No                | 32                  | 5.0                |
| MAX1490B | 1/1          | 0.25                        | Full             | Yes               | 32                  | 5.0                |
| MAX3480A | 1/1          | 2.50                        | Half             | No                | 32                  | 3.3                |
| MAX3480B | 1/1          | 0.25                        | Half             | Yes               | 128                 | 3.3                |

## Package Information



# Complete, Isolated, 3.3V RS-485/RS-422 Data Interface

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