**General Description**

The MAX1480A/MAX1480B/MAX1490A/MAX1490B are complete, electrically isolated, RS-485/RS-422 data-communications interface solutions. Transceivers, opto-couplers, and a transformer provide a complete interface in a standard DIP package. A single +5V supply on the logic side powers both sides of the interface.

The MAX1480B/MAX1490B feature 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 MAX1480A/MAX1490A driver slew rate is not limited, allowing transmission rates up to 2.5Mbps. The MAX1480A/B are designed for half-duplex communication, while the MAX1490A/B feature full-duplex communication.

Drivers are short-circuit current limited and 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 known output (RO low for the MAX1480A/B, RO high for the MAX1490A/B) if the input is open circuit.

The MAX1480A/MAX1480B/MAX1490A/MAX1490B typically withstand 1600V RMS (1 minute) or 2000V RMS (1 second). Their isolated outputs meet all RS-485/RS-422 specifications. The MAX1480A/B are available in a 28-pin DIP package, and the MAX1490A/B are available in a 24-pin DIP package.

**Features**

- Isolated Data Interface, Typically to 1600V RMS (1 minute)
- Slew-Rate Limited for Errorless Data Transmission (MAX1480B/MAX1490B)
- High-Speed, Isolated, 2.5Mbps RS-485/RS-422 Interface (MAX1480A/MAX1490A)
- Full-Duplex Data Communication (MAX1490A/B)
- -7V to +12V Common-Mode Input Voltage Range with Respect to Isolated Ground
- Single +5V Supply
- Current Limiting and Thermal Shutdown for Driver Overload Protection

**Ordering Information**

<table>
<thead>
<tr>
<th>PART</th>
<th>TEMP. RANGE</th>
<th>PIN-PACKAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX1480ACPI</td>
<td>0°C to +70°C</td>
<td>28 Wide Plastic DIP</td>
</tr>
<tr>
<td>MAX1480AEPI</td>
<td>-40°C to +85°C</td>
<td>28 Wide Plastic DIP</td>
</tr>
</tbody>
</table>

Ordering Information continued at end of data sheet.

**Selection Table**

<table>
<thead>
<tr>
<th>PART</th>
<th>HALF/FULL DUPLEX</th>
<th>DATA RATE (Mbps)</th>
<th>SLEW-RATE LIMITED</th>
<th>DRIVER ENABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX1480A</td>
<td>Half</td>
<td>2.5</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>MAX1480B</td>
<td>Half</td>
<td>0.25</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>MAX1490A</td>
<td>Full</td>
<td>2.5</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>MAX1490B</td>
<td>Full</td>
<td>0.25</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

**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

**Pin Configurations**

Pin Configurations continued at end of data sheet.
Complete, Isolated, RS-485/RS-422 Data Interface

ABSOLUTE MAXIMUM RATINGS

With Respect to GND_:
- Supply Voltage (VCC_) : -0.3V to +6V
- Control Input Voltage (SD, FS) : -0.3V to (VCC_ + 0.3V)
- Receiver Output Voltage (RO, RO) : -0.3V to (VCC_ + 0.3V)
- Output Switch Voltage (D1, D2) : +12V

With Respect to ISO COM_:
- Control Input Voltage (ISO DE_ ) : -0.3V to (ISO VCC_ + 0.3V)
- Driver Input Voltage (ISO DI_ ) : -0.3V to (ISO VCC_ + 0.3V)
- Receiver Output Voltage (ISO RO_) : -0.3V to (ISO VCC_ + 0.3V)
- Driver Output Voltage (A, B, Y, Z ) : -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):
- 24-Pin Plastic DIP (derate 8.7mW°C above +70°C) : 696mW
- 28-Pin Plastic DIP (derate 9.09mW°C above +70°C) : 727mW

Operating Temperature Ranges:
- MAX1480_CPI/MAX1490_CPI : 0°C to +70°C
- MAX1480_EPI/MAX1490_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_ = 5V ±10%, FS = 0V, TA = TMIN to TMAX, unless otherwise noted. Typical values are at VCC_ = 5V and TA = +25°C.)

(Notes 1, 2)
## ELECTRICAL CHARACTERISTICS (continued)

(VCC = 5V ±10%, FS = 0V, TA = TMIN to TMAX, unless otherwise noted. Typical values are at VCC = 5V and TA = +25°C.)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differential Driver Output (no load)</td>
<td>VOD1</td>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Differential Driver Output (with load)</td>
<td>VOD2</td>
<td>R = 50Ω (RS-422)</td>
<td>2</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Change in Magnitude of Driver Output Voltage</td>
<td>ΔVOD</td>
<td>R = 27Ω or 50Ω, Figure 4</td>
<td>Differential</td>
<td>0.3</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>for Complementary Output States</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Driver Common-Mode Output</td>
<td>VCC</td>
<td>R = 27Ω or 50Ω, Figure 4</td>
<td>4</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Input Current (A, B)</td>
<td>ISO IIN</td>
<td>DE' = 0V, VCC = 0V or 5.5V</td>
<td>VIN = 12V</td>
<td>1.0</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Receiver Input Resistance</td>
<td>RI</td>
<td>-7V ≤ VCM ≤ 12V</td>
<td>12</td>
<td></td>
<td></td>
<td>kΩ</td>
</tr>
<tr>
<td>Receiver Differential Threshold</td>
<td>VTH</td>
<td>-7V ≤ VCM ≤ 12V</td>
<td>0.2</td>
<td>0.2</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Receiver Input Hysteresis</td>
<td>ΔVTH</td>
<td>VCM = 0V</td>
<td>70</td>
<td></td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>Receiver Output/Receiver Output Low Voltage</td>
<td>VOL</td>
<td>Using resistor values listed in Tables 1 and 2</td>
<td>0.4</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Receiver Output/Receiver Output High Current</td>
<td>IOH</td>
<td>VOUT = 5.5V</td>
<td>250</td>
<td></td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>Driver Short-Circuit Current</td>
<td>ISO ISO</td>
<td>-7V ≤ VO ≤ 12V (Note 4)</td>
<td>100</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>

### SWITCHING CHARACTERISTICS—MAX1480A/MAX1490A

(VCC = 5V ±10%, FS = 0V, TA = TMIN to TMAX, unless otherwise noted. Typical values are at VCC = 5V and TA = +25°C.)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver Input to Output Propagation Delay</td>
<td>tPLH</td>
<td>Figures 5 and 7, RDIFF = 54Ω, C1 = C2 = 100pF</td>
<td>100</td>
<td>275</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Driver Output Skew</td>
<td>tPGW</td>
<td>Figures 5 and 7, RDIFF = 54Ω, C1 = C2 = 100pF</td>
<td>25</td>
<td>90</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Driver Rise or Fall Time</td>
<td>tR, tF</td>
<td>Figures 5 and 7, RDIFF = 54Ω, C1 = C2 = 100pF</td>
<td>15</td>
<td>40</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Driver Enable to Output High (MAX1480A only)</td>
<td>tZH</td>
<td>Figures 6 and 8, C1 = 100pF, S2 closed</td>
<td>0.5</td>
<td>1.5</td>
<td></td>
<td>μs</td>
</tr>
<tr>
<td>Driver Enable to Output Low (MAX1480A only)</td>
<td>tZL</td>
<td>Figures 6 and 8, C1 = 100pF, S1 closed</td>
<td>0.5</td>
<td>1.5</td>
<td></td>
<td>μs</td>
</tr>
<tr>
<td>Driver Disable Time from Low (MAX1480A only)</td>
<td>tLZ</td>
<td>Figures 6 and 8, C1 = 15pF, S1 closed</td>
<td>0.5</td>
<td>1.5</td>
<td></td>
<td>μs</td>
</tr>
<tr>
<td>Driver Disable Time from High (MAX1480A only)</td>
<td>tHZ</td>
<td>Figures 6 and 8, C1 = 15pF, S2 closed</td>
<td>0.5</td>
<td>1.5</td>
<td></td>
<td>μs</td>
</tr>
<tr>
<td>Receiver Input to Output Propagation Delay</td>
<td>tPLH</td>
<td>Figures 5 and 10, RDIFF = 54Ω, C1 = C2 = 100pF</td>
<td>100</td>
<td>225</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Receiver Input to Output Propagation Delay</td>
<td>tPHL</td>
<td>100</td>
<td>225</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>lPLH - lPHL</td>
<td>Differential Receiver Skew</td>
<td>tSKD</td>
<td>Figures 5 and 10, RDIFF = 54Ω, C1 = C2 = 100pF</td>
<td>20</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Maximum Data Rate</td>
<td>fMAX</td>
<td>tPLH, tPHL &lt; 50% of data period</td>
<td>2.5</td>
<td></td>
<td></td>
<td>Mbps</td>
</tr>
<tr>
<td>Time to Shutdown</td>
<td>tSHDN</td>
<td>100</td>
<td></td>
<td>μs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shutdown to Driver Output High</td>
<td>tZH(SHDN)</td>
<td>Figures 6 and 9, C1 = 100pF, S2 closed</td>
<td>3</td>
<td>10</td>
<td></td>
<td>μs</td>
</tr>
<tr>
<td>Shutdown to Driver Output Low</td>
<td>tZL(SHDN)</td>
<td>Figures 6 and 9, C1 = 100pF, S1 closed</td>
<td>3</td>
<td>10</td>
<td></td>
<td>μs</td>
</tr>
</tbody>
</table>
Complete, Isolated, RS-485/RS-422 Data Interface

SWITCHING CHARACTERISTICS—MAX1480B/MAX1490B

(VCC_ = 5V ±10%, FS = 0V, TA = TM, unless otherwise noted. Typical values are at VCC_ = 5V and TA = +25°C.)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver Input to Output Propagation Delay</td>
<td>tPLH</td>
<td>Figures 5 and 7, RD = 5kΩ, CL1 = CL2 = 100pF</td>
<td>1.0 μs</td>
</tr>
<tr>
<td></td>
<td>tPHL</td>
<td>Figures 5 and 7, RD = 5kΩ, CL1 = CL2 = 100pF</td>
<td>1.0 μs</td>
</tr>
<tr>
<td>Driver Output Skew</td>
<td>tSKW</td>
<td>Figures 5 and 7, RD = 5kΩ, CL1 = CL2 = 100pF</td>
<td>100 ns</td>
</tr>
<tr>
<td>Driver Enable to Output High (MAX1480B only)</td>
<td>tZH</td>
<td>Figures 6 and 8, CL = 100pF, S2 closed</td>
<td>35 μs</td>
</tr>
<tr>
<td>Driver Enable to Output Low (MAX1480B only)</td>
<td>tZL</td>
<td>Figures 6 and 8, CL = 100pF, S1 closed</td>
<td>35 μs</td>
</tr>
<tr>
<td>Driver Disable Time from Low (MAX1480B only)</td>
<td>tLZ</td>
<td>Figures 6 and 8, CL = 15pF, S1 closed</td>
<td>13 μs</td>
</tr>
<tr>
<td>Driver Disable Time from High (MAX1480B only)</td>
<td>tHZ</td>
<td>Figures 6 and 8, CL = 15pF, S2 closed</td>
<td>13 μs</td>
</tr>
<tr>
<td>Receiver Input to Output Propagation Delay</td>
<td>tPLH</td>
<td>Figures 5 and 10, RD = 5kΩ, CL1 = CL2 = 100pF</td>
<td>0.8 μs</td>
</tr>
<tr>
<td></td>
<td>tPHL</td>
<td>Figures 5 and 10, RD = 5kΩ, CL1 = CL2 = 100pF</td>
<td>0.8 μs</td>
</tr>
<tr>
<td>tPLH - tPHL</td>
<td>Differential Receiver Skew</td>
<td>tSKD</td>
<td>Figures 5 and 10, RD = 5kΩ, CL1 = CL2 = 100pF</td>
</tr>
<tr>
<td>Maximum Data Rate</td>
<td>fMAX</td>
<td>tPLH, tPHL &lt; 50% of data period</td>
<td>0.25 Mbps</td>
</tr>
<tr>
<td>Time to Shutdown</td>
<td>tSHDN</td>
<td>Figures 6 and 9, CL = 100pF, S2 closed</td>
<td>100 μs</td>
</tr>
<tr>
<td>Shutdown to Driver Output High</td>
<td>tZH(SH)</td>
<td>Figures 6 and 9, CL = 100pF, S2 closed</td>
<td>35 μs</td>
</tr>
<tr>
<td>Shutdown to Driver Output Low</td>
<td>tZL(SH)</td>
<td>Figures 6 and 9, CL = 100pF, S1 closed</td>
<td>35 μs</td>
</tr>
</tbody>
</table>

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 (GND_), unless otherwise specified.

Note 2: For DE’ and DI’ pin descriptions, see Detailed Block Diagram and Typical Application Circuit (Figure 1 for MAX1480A/MAX1480B, Figure 2 for MAX1490A/MAX1490B).

Note 3: Shutdown supply current is the current at VCC1 and VCC2 when shutdown is enabled.

Note 4: Applies to peak current (see Typical Operating Characteristics). Although the MAX1480A/B and MAX1490A/B provide electrical isolation between logic ground and signal paths, they do not provide isolation between external shields and the signal paths (see Isolated Common Connection section).
Complete, Isolated, RS-485/RS-422 Data Interface

**Typical Operating Characteristics**

(VCC_ = 5V, T_A = +25°C, unless otherwise noted.)

---

**Output Current vs. Receiver Output Low Voltage**

- Measured at ISO RO DRV

**Output Current vs. Receiver Output High Voltage**

- Measured at ISO RO DRV

**Receiver Output High Voltage vs. Temperature**

**Output Current vs. Temperature**

**Receiver Output Low Voltage vs. Temperature**

**Driver Output Current vs. Differential Output Voltage**

**Driver Differential Output Voltage vs. Temperature**

**Driver Output Current vs. Driver Output Low Voltage**

**Driver Output Current vs. Driver Output High Voltage**

**MAX1480B/MAX1490B Shutdown Current vs. Temperature**

**MAX1480B/MAX1490B Shutdown Current vs. Temperature**

---

**MAX1480A/B, MAX1490A/B**
Complete, Isolated, RS-485/RS-422 Data Interface

Typical Operating Characteristics (continued)

(VCC_ = 5V, TA = +25°C, unless otherwise noted.)

**MAX1480A/MAX1490A**

- **Unloaded Supply Current vs. Temperature**
  - **MAX1480A:**
    - VCC = 5.5V
    - VCC = 5.0V
    - VCC = 4.5V
  - **MAX1490A:**
    - VCC = 5.5V
    - VCC = 5.0V
    - VCC = 4.5V

**MAX1480B/MAX1490B**

- **Unloaded Supply Current vs. Temperature**
  - **MAX1480B:**
    - VCC = 5.5V
    - VCC = 4.5V
    - VCC = 5.0V
  - **MAX1490B:**
    - VCC = 5.5V
    - VCC = 4.5V
    - VCC = 5.0V

**MAX1480A/MAX1490A**

- **Loaded Supply Current vs. Temperature**
  - **MAX1480A:**
    - FS = 0V
    - RL = ∞
    - DE’ = VCC
  - **MAX1490A:**
    - VCC = 5.5V
    - VCC = 5.0V
    - VCC = 4.5V

**MAX1480B/MAX1490B**

- **Loaded Supply Current vs. Temperature**
  - **MAX1480B:**
    - FS = 0V
    - RL = 54Ω
    - DE’ (MAX1480B ONLY) = VCC
  - **MAX1490B:**
    - VCC = 5.5V
    - VCC = 4.5V
    - VCC = 5.0V

**Driver Disable Time vs. Temperature**

- **MAX1480A:**
  - VCC = 5.5V
  - VCC = 4.5V
  - VCC = 5.0V
- **MAX1480B:**
  - RL = 54Ω
  - DE’ = VCC

**Driver Enable Time vs. Temperature**

- **MAX1480A:**
  - VCC = 5.5V
  - VCC = 4.5V
  - VCC = 5.0V
- **MAX1480B:**
  - RL = 54Ω
  - DE’ = VCC
Complete, Isolated, RS-485/RS-422 Data Interface

Typical Operating Characteristics (continued)

(VCC_ = 5V, TA = +25°C, unless otherwise noted.)

MAX1480A/MAX1490A
POWER-UP DELAY TO DRIVER OUTPUTS VALID

MAX1480B
DRIVER ENABLE TIME

MAX1480B
DRIVER DISABLE TIME

MAX1480A
DRIVER ENABLE TIME

MAX1480A
DRIVER DISABLE TIME

(VCC_ = 5.0V, DI-= 0V
SD = 5V TO 0V AT 1kHz
DE' TOGGLED 0V TO 5V AT 5kHz

(VCC_ = 5.0V, DI-= 0V
DE' TOGGLED 0V TO 5V AT 5kHz

(VCC_ = 5.0V, DI-= 0V
DE' TOGGLED 0V TO 5V AT 5kHz

(VCC_ = 5.0V, DI-= 0V
DE' TOGGLED 0V TO 5V AT 5kHz

(VCC_ = 5.0V, DI-= 0V
DE' TOGGLED 0V TO 5V AT 5kHz
Complete, Isolated, RS-485/RS-422 Data Interface

Typical Operating Characteristics (continued)

(V_{CC} = 5V, T_A = +25°C, unless otherwise noted.)

MAX1480A/MAX1490A

**Receiver t\(_{PHL}\)**

- **Input A:** 1V/div
- **Input B:** 1V/div
- **RO:** 2V/div
- **20ns/div**

V_{CC} = 5.0V, DE = V_{CC}, DI\(^{-}\) = 0V TO 5V AT 1.25MHz

MAX1480B/MAX1490B

**Receiver t\(_{PHL}\)**

- **Input A:** 1V/div
- **Input B:** 1V/div
- **RO:** 2V/div
- **200ns/div**

V_{CC} = 5.0V, DE = V_{CC}, DI\(^{-}\) = 0V TO 5V AT 125kHz

MAX1480A/MAX1490A

**Receiver t\(_{PLH}\)**

- **Input A:** 1V/div
- **Input B:** 1V/div
- **RO:** 2V/div
- **20ns/div**

V_{CC} = 5.0V, DE = V_{CC}, DI\(^{-}\) = 0V TO 5V AT 1.25MHz

MAX1480B/MAX1490B

**Receiver t\(_{PLH}\)**

- **Input A:** 1V/div
- **Input B:** 1V/div
- **RO:** 2V/div
- **500ns/div**

V_{CC} = 5.0V, DE = V_{CC}, DI\(^{-}\) = 0V TO 5V AT 125kHz
# Pin Descriptions

## PINS ON THE NON-ISOLATED SIDE

<table>
<thead>
<tr>
<th>PIN</th>
<th>NAME</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 8, 10</td>
<td>S1, S2</td>
<td>Logic-Side (non-isolated side) +5V Supply Voltages.</td>
</tr>
<tr>
<td>3, 4</td>
<td>D1, D2</td>
<td>Internal Connections. Leave these pins unconnected.</td>
</tr>
<tr>
<td>5</td>
<td>GND1</td>
<td>Logic-Side Ground. Connect to GND2 (pin 12).</td>
</tr>
<tr>
<td>6</td>
<td>FS</td>
<td>Frequency Switch Input. If FS = VCC, or is open, switch frequency is high; if FS = 0V, switch frequency is low.</td>
</tr>
<tr>
<td>7</td>
<td>SD</td>
<td>Shutdown Input. Ground for normal operation. When high, the power oscillator is disabled.</td>
</tr>
<tr>
<td>9</td>
<td>DI</td>
<td>Driver Input. With DE high (MAX1480A/B only), 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 a resistor (Table 1 of Figure 1 for MAX1480, Table 2 of Figure 2 for MAX1490).</td>
</tr>
<tr>
<td>11</td>
<td>DE</td>
<td>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 a resistor (Table 1 of Figure 1).</td>
</tr>
<tr>
<td>12</td>
<td>GND2</td>
<td>Logic-Side Ground. Connect to GND1 (pin 5).</td>
</tr>
<tr>
<td>13</td>
<td>RO</td>
<td>Receiver Output. If A &gt; B by 200mV, RO will be high; if A &lt; B by 200mV, RO will be low. Open collector; must have pull-up to VCC (Table 2 of Figure 2).</td>
</tr>
<tr>
<td>14</td>
<td>VCC5</td>
<td>Logic-Side (non-isolated side) +5V Supply Voltage</td>
</tr>
</tbody>
</table>

## PINS ON THE ISOLATED RS-485/RS-422 SIDE

<table>
<thead>
<tr>
<th>PIN</th>
<th>NAME</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>ISO RO LED</td>
<td>Isolated Receiver Output LED. Internal LED anode in MAX1480 and LED cathode in MAX1490. Connect to ISO RO DRV through a resistor (Table 1 of Figure 1 for MAX1480; Table 2 of Figure 2 for MAX1490).</td>
</tr>
<tr>
<td>16</td>
<td>ISO COM2</td>
<td>Isolated Common. Connect to ISO COM1 (pin 20).</td>
</tr>
<tr>
<td>17</td>
<td>ISO DE DRV</td>
<td>Isolated Driver-Enable Drive. 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. Open-collector output; must have pull-up to ISO VCC and be tied to ISO DE IN for normal operation (Table 1 of Figure 1).</td>
</tr>
<tr>
<td>18</td>
<td>ISO VCC2</td>
<td>Isolated Supply Voltage. Connect to ISO VCC1 (pin 26 for MAX1480, or pin 22 for MAX1490).</td>
</tr>
<tr>
<td>19</td>
<td>ISO DI DRV</td>
<td>Isolated Driver-Input Drive. With DE high (MAX1480 only), 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. Connect to ISO DI IN (on the MAX1480 only) for normal operation. Open-collector output; connect a pull-up resistor to ISO VCC (Table 1 of Figure 1 for MAX1480; Table 2 of Figure 2 for MAX1490).</td>
</tr>
<tr>
<td>20</td>
<td>ISO COM1</td>
<td>Isolated Common. For MAX1480, connect to ISO COM2 (pin 16) (Figures 1 and 2).</td>
</tr>
</tbody>
</table>
Complete, Isolated, RS-485/RS-422 Data Interface

**Detailed Description**

The MAX1480A/MAX1480B/MAX1490A/MAX1490B are complete, electrically isolated, RS-485/RS-422 data-communications interface solutions. Transceivers, optocouplers, a power driver, and a transformer in one standard 28-pin DIP package (24-pin for the MAX1490A/B) provide a complete interface. Signals and power are internally transported across the isolation barrier (Figures 1, 2). 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 +5V supply on the logic side powers both sides of the interface. The MAX1480A/B offer half-duplex communications while the MAX1490A/B feature full-duplex communication. The functional input/output relationships are shown in Tables 3–6.

The MAX1480B/MAX1490B feature 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 MAX1480A/MAX1490A driver slew rate is not limited, allowing transmission rates up to 2.5Mbps. The MAX1480B/MAX1490B shutdown feature reduces supply current to as low as 0.2µA by using the SD pin (see Low-Power Shutdown Mode section).

Use the FS pin to select between high and low switching frequencies for the isolated power driver. The driver switches at the lower frequency (200kHz for the MAX1480A/B, 535kHz for the MAX1490A/B) when FS is low, and at the higher frequency (350kHz for the MAX1480A/B, 725kHz for the MAX1490A/B) when FS is high. At the lower switching frequency, the devices’ operating voltage ranges increase from 5V ±5% to 5V ±10%.

The FS pin has a weak internal pull-up that switches the device to the high-frequency mode when FS is left unconnected. With FS high or open, no-load supply current is reduced by approximately 4mA, and by up to 8mA when fully loaded.

Drivers are short-circuit current limited and are protected against excessive power dissipation by thermal 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 RO (logic-low RO) output if the input is open circuit.

On the MAX1480A/B, the driver outputs are enabled by bringing DE high. Driver-enable times are typically 0.5µs for the MAX1480A and 35µs for the MAX1480B. Allow time for the devices to be enabled before sending data (see the Driver Enable Time vs. Temperature graph in the Typical Operating Characteristics). 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 MAX1480A/MAX1480B/MAX1490A/MAX1490B typically withstand 1600V RMS (1 minute) or 2000V RMS (1 second). The logic inputs can be driven from TTL/CMOS-logic with a series resistor, and the received data output can directly drive TTL or CMOS-logic families with only resistive pull-up.

**Low-Power Shutdown Mode**

The SD pin shuts down the oscillator on the internal power driver. With the primary side in shutdown, no power is transferred across the isolation barrier. The DI and DE optocouplers, however, still consume current if the drive signals on the non-isolated side are low. Therefore, leave DI’ and DE’ high or floating when in shutdown mode.
Complete, Isolated, RS-485/RS-422 Data Interface

Under these conditions, the MAX1480B/MAX1490B supply current is reduced to as low as 0.2µA.

The high-speed optocouplers on the MAX1480A/MAX1490A consume an additional 10mA through VCC5 (VCC4 for the MAX1490A). Therefore, to completely shut down these devices, use an external P-channel MOSFET as shown in Figure 3. In normal operation, SD is low, turning the MOSFET on and thereby providing power to all the VCC pins. When SD is pulled high, the power oscillator is disabled and the switch is turned off, disconnecting power from the DI and DE optocouplers. In normal operating mode, the switch carries only the optocoupler currents, so an on-resistance of several ohms will not significantly degrade efficiency.

Table 2. Pull-Up and LED Drive Resistors

<table>
<thead>
<tr>
<th>PART</th>
<th>R1 (Ω)</th>
<th>R2 (Ω)</th>
<th>R3 (Ω)</th>
<th>R4 (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX1490A</td>
<td>200</td>
<td>1000</td>
<td>330</td>
<td>1000</td>
</tr>
<tr>
<td>MAX1490B</td>
<td>200</td>
<td>3000</td>
<td>330</td>
<td>3000</td>
</tr>
</tbody>
</table>

Figure 2. MAX1490A/MAX1490B Detailed Block Diagram and Typical Application Circuit
Complete, Isolated, RS-485/RS-422 Data Interface

Figure 3. MAX1480A Low-Power Shutdown Mode

Test Circuits

Figure 4. Driver DC Test Load

Figure 5. Driver/Receiver Timing Test Circuit
Complete, Isolated, RS-485/RS-422 Data Interface

**Test Circuits (continued)**

**Switching Waveforms**

**Figure 7. Driver Propagation Delays and Transition Times**

**Figure 8. Driver Enable and Disable Times**

**Figure 9. Times to/from Shutdown**

**Figure 10. Receiver Propagation Delays**
**Complete, Isolated, RS-485/RS-422 Data Interface**

**MAX1480B/MAX1490B: Reduced EMI and Reflections**

The MAX1480B/MAX1490B are slew-rate-limited, minimizing EMI and reducing reflections caused by improperly terminated cables. Figure 11 shows both the driver output waveform of a MAX1480A/MAX1490A transmitting a 150kHz signal and the Fourier analysis of that waveform. High-frequency harmonics with large amplitudes are evident. Figure 12 shows the same information for the slew-rate-limited MAX1480B/MAX1490B transmitting the same signal. The high-frequency harmonics have much lower amplitudes, and therefore the potential for EMI is significantly reduced.

**Function Tables**

**Half-Duplex Devices** (MAX1480A/MAX1480B)

**Table 3. Transmitting**

<table>
<thead>
<tr>
<th>INPUTS*</th>
<th>OUTPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE</td>
<td>DI</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>X</td>
</tr>
</tbody>
</table>

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

**Full-Duplex Devices** (MAX1490A/MAX1490B)

**Table 4. Receiving**

<table>
<thead>
<tr>
<th>INPUTS*</th>
<th>OUTPUT (RO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE</td>
<td>VA - VB</td>
</tr>
<tr>
<td>0</td>
<td>≥ +0.2V</td>
</tr>
<tr>
<td>0</td>
<td>≤ -0.2V</td>
</tr>
<tr>
<td>0</td>
<td>Open</td>
</tr>
</tbody>
</table>

**Table 5. Transmitting**

<table>
<thead>
<tr>
<th>INPUT (DI)*</th>
<th>OUTPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>Y</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 6. Receiving**

<table>
<thead>
<tr>
<th>INPUT* (VA - VB)</th>
<th>OUTPUT (RO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ +0.2V</td>
<td>1</td>
</tr>
<tr>
<td>≤ -0.2V</td>
<td>0</td>
</tr>
<tr>
<td>Open</td>
<td>1</td>
</tr>
</tbody>
</table>

* For DE and DI’ pin descriptions, see Detailed Block Diagram and Typical Application Circuit (Figure 1 for MAX1480A/B, Figure 2 for MAX1490A/B).
Complete, Isolated, RS-485/RS-422 Data Interface

Figure 13. Typical Half-Duplex RS-485/RS-422 Network
**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 entire common-mode 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.

**Propagation Delay Skew**

Typical propagation delays are shown in the Typical Operating Characteristics using the test circuit of Figure 5. Propagation delay skew is simply the difference between the low-to-high and high-to-low propagation delay. Small driver/receiver skew times help reduce EMI and reflections by maintaining balanced differential signals.

The receiver skew time, \( t_{PLH} - t_{PHL} \) is typically under 100ns for the MAX1480A/MAX1490A and under 1µs for the MAX1480B/MAX1490B.

The driver skew time is typically 25ns for the MAX1480A/MAX1490A and 100ns for the MAX1480B/MAX1490B.

**Applications Information**

DI and DE are intended to be driven through a series current-limiting resistor. Directly grounding these pins destroys the device.

The MAX1480A/MAX1480B are designed for bidirectional data communications on multipoint bus-transmission lines. The MAX1490A/MAX1490B are designed for full-duplex bidirectional communications that are primarily point-to-point. Figures 13 and 14 show half-duplex and full-duplex typical network application circuits, respectively. 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 MAX1480B/MAX1490B are more tolerant of imperfect termination and stubs off the main line.

**Layout Considerations**

The MAX1480A/MAX1480B/MAX1490A/MAX1490B pinouts enable optimal PC board layout by minimizing interconnect lengths and crossovers.

- For maximum isolation, the "isolation barrier" should not be breached except by the MAX1480A/MAX1480B/MAX1490A/MAX1490B. Connections...
and components from one side should not be located near those of the other side.

- A shield trace connected to the ground on each side of the barrier can help intercept capacitive currents that might otherwise couple into the signal path. In a double-sided or multilayer board, these shield traces should be present on all conductor layers.
- Try to maximize the width of the isolation barrier wherever possible; a clear space of at least 0.25 inches between ground and isolated common is suggested.

Pull-Up and LED Drive Resistors

The MAX1480A/MAX1480B/MAX1490A/MAX1490B are specified and characterized using the resistor values shown in Table 1 of Figure 1 and Table 2 of Figure 2. Altering the recommended values can degrade performance.

The DI and DE (MAX1480A/B only) inputs are the cathodes of LEDs whose anodes are connected to the supply. These points are best driven by a CMOS-logic gate with a series resistor to limit the current. The resistor values shown in Tables 1 and 2 are recommended when the 74HC86 gate or equivalent is used. These values may need to be adjusted if a driving gate with dissimilar series resistance is used.

All pull-up resistors are based on optocoupler specifications in order to optimize the devices' data-transfer rates.

Isolated Common Connection

The isolated common may be completely floating with respect to the logic ground and the effective network ground. The receiver input resistors will cause the isolated common voltage to go to the mean voltage of the receiver inputs. If using shielded cable, tie the isolated common to the shield through a 100Ω resistor. In the case of the MAX1490, each shield should have its own 100Ω resistor (Figures 1, 2, 13, and 14).

Figure 15. Doubly Isolated RS-485 Repeater
**Doubly Isolated RS-485 Repeater**

The RS-422/RS-485 standard is specified for cable lengths up to 4000 feet. When approaching or exceeding the specified maximum cable length, a ground-potential difference of several tens of volts can easily develop. This difference can be either DC, AC, at power-line frequency, or any imaginable noise or impulse waveform. It is typically very low impedance so that if a connection between the two grounds is attempted, very large currents may flow. These currents are by their nature unstable and unpredictable. In addition, they may cause noise to be injected into sensitive instrumentation and, in severe cases, might actually cause physical damage to such equipment.

Figure 15 shows a half-duplex (two-wire), bidirectional, party-line repeater system that prevents interference and/or damage from ground-potential differences. Two MAX1480A/MAX1480B isolated RS-485 transceivers are used to isolate each of the network segments from the electrical environment of the repeater. The MAX1480A/MAX1480B also regenerate bus signals that may have been degraded by line attenuation or dispersion.

In the idle state, both transmitters are disabled, while all receivers in the system are enabled. If any device on the system has information for any other device, it starts sending its data onto the bus. Each data transmission on the bus retriggers the one-shot, keeping the sending transmitter enabled until there are no more transmissions. All receivers receive all data; if this is undesirable, the protocol must allow for an address field so receivers can ignore data not directed to them.

Each node must refrain from transmitting when data already exists on the bus, and must resend data that is corrupted by the collisions that inevitably occur with a party-line system. With the repeater of Figure 15, there might be transmitters up to 8000 feet apart. That represents more than 8µs (assuming 1ns/foot of delay) in which two nodes could be transmitting simultaneously.

The circuit in Figure 15 can be used either directly as shown, with the slew-rate-limited MAX1480B, for data transfer rates up to 250kbps, or with the MAX1480A for data rates up to 2.5Mbps (see Table 1 for pull-up and LED resistor values when using the MAX1480A). If dual-port isolation is not needed, one of the MAX1480 devices can be replaced by a MAX485 for 2.5Mbps applications, or by a MAX483 for 250kbps applications.
Complete, Isolated, RS-485/RS-422 Data Interface

Ordering Information (continued)

<table>
<thead>
<tr>
<th>PART†</th>
<th>TEMP. RANGE</th>
<th>PIN-PACKAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX1480B CPI</td>
<td>0°C to +70°C</td>
<td>28 Wide Plastic DIP</td>
</tr>
<tr>
<td>MAX1480B EPI</td>
<td>-40°C to +85°C</td>
<td>28 Wide Plastic DIP</td>
</tr>
<tr>
<td>MAX1490A CPG</td>
<td>0°C to +70°C</td>
<td>24 Wide Plastic DIP</td>
</tr>
<tr>
<td>MAX1490A EPG</td>
<td>-40°C to +85°C</td>
<td>24 Wide Plastic DIP</td>
</tr>
<tr>
<td>MAX1490B CPG</td>
<td>0°C to +70°C</td>
<td>24 Wide Plastic DIP</td>
</tr>
<tr>
<td>MAX1490B EPG</td>
<td>-40°C to +85°C</td>
<td>24 Wide Plastic DIP</td>
</tr>
</tbody>
</table>

Ordering Information (continued)

1. Data rate for “A” parts is up to 2500kbps. Data rate for “B” parts is up to 250kbps.

Pin Configurations (continued)

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