

Low-Power, Slew-Rate-Limited RS-485/RS-422 Transceivers MAX485

DESCRIPTION

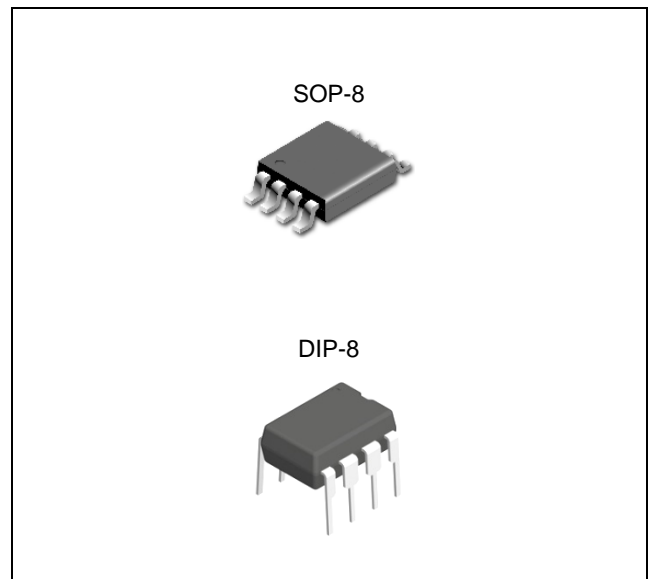
The MAX485 is a half-duplex transceiver that meets the specifications of RS-485 and RS-422. Its BiCMOS design allows low power operation without sacrificing performance. The MAX485 meets the requirements of the RS-485 and RS-422 protocols up to 5Mbps underload. The ESD tolerance is more than $\pm 8\text{kV}$ for both Human Body Model and $\pm 15\text{kV}$ for IEC61000-4-2 Air Discharge Method on this device.

FEATURES

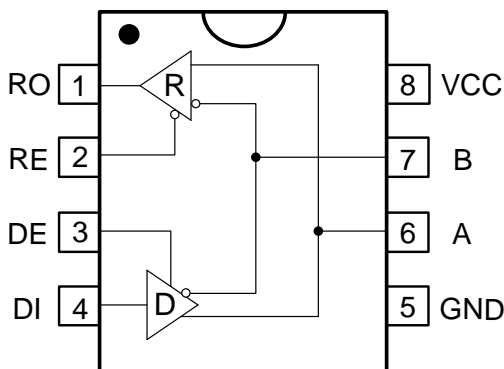
- Single +5V Supply
- Low Power BiCMOS
- Driver/Receiver Enable for Multi-Drop Configurations
- Half-Duplex Versions Available
- Data rate: 5 Mbps
- ESD Specifications
 - $\pm 15\text{kV}$ IEC61000-4-2 Air Discharge
 - $\pm 8\text{kV}$ Human Body Model

APPLICATIONS

- Low Power RS-485 Systems
- DTE-DCE Interface
- Packet Switching
- Local Area Networks
- Data Concentration
- Data Multiplexers
- Integrated Services Digital Network (ISDN)



PIN CONFIGURATION AND LOGIC DIAGRAM



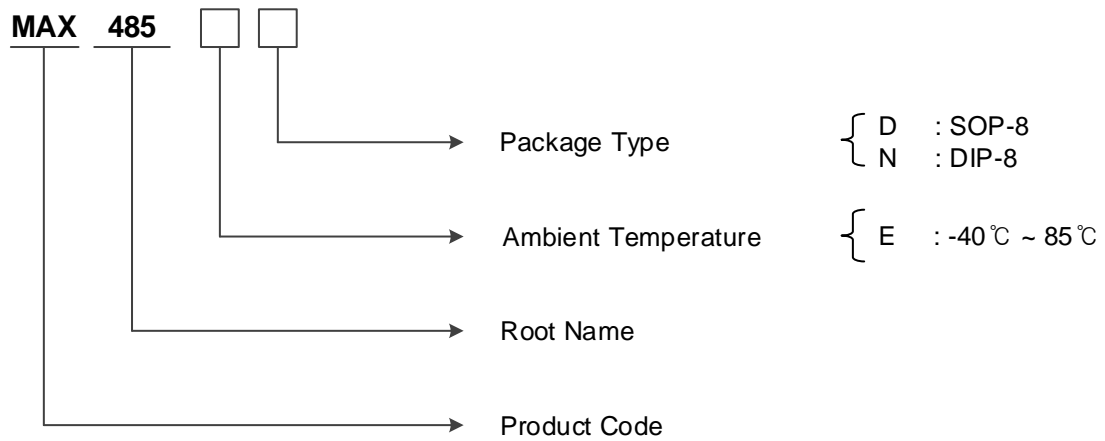
TRUTH TABLE

| Transmission | | | | |
|--------------|----|---------------------|---------|---|
| Inputs | | | Outputs | |
| RE | DE | DI | A | B |
| X | 1 | 1 | 1 | 0 |
| X | 1 | 0 | 0 | 1 |
| 0 | 0 | X | Z | Z |
| 1 | 0 | X | Z | Z |
| Receiver | | | | |
| Inputs | | | Outputs | |
| RE | DE | A-B | RO | |
| 0 | 0 | $\geq +0.2\text{V}$ | 1 | |
| 0 | 0 | $\leq -0.2\text{V}$ | 0 | |
| 0 | 0 | Open | 1 | |
| 1 | 0 | X | Z | |

Low-Power, Slew-Rate-Limited RS-485/RS-422 Transceivers **MAX485**

ORDERING INFORMATION

| Package | Oder No. | Description | Marking | Compliance | Status |
|---------|----------|----------------------------|---------|-------------|------------|
| SOP-8 | MAX485ED | RS-485/RS-422 Transceivers | MAX485E | RoHS, Green | Active |
| DIP-8 | MAX485EN | RS-485/RS-422 Transceivers | MAX485E | RoHS, Green | Contact us |



Low-Power, Slew-Rate-Limited RS-485/RS-422 Transceivers MAX485

ABSOLUTE MAXIMUM RATINGS

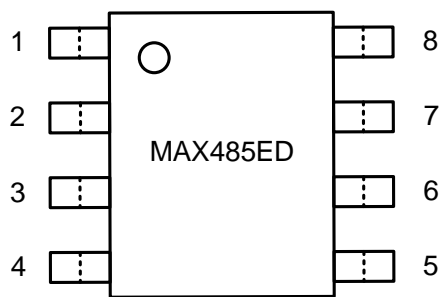
| Characteristic | Symbol | Min | Max | Unit |
|---------------------------|------------------|------|----------------|------|
| Supply Voltage | V_{CC} | | 7 | V |
| Control Input Voltage | V_{DE}, V_{RE} | -0.3 | $V_{CC} + 0.5$ | V |
| Driver Input Voltage | V_{DI} | -0.3 | $V_{CC} + 0.5$ | V |
| Driver Output Voltage | A, B | -15 | 15 | V |
| Receiver Input Voltage | A, B | -15 | 15 | V |
| Receiver Output Voltage | V_{RO} | -0.3 | $V_{CC} + 0.5$ | V |
| Junction Temperature | T_J | -40 | 125 | °C |
| Storage Temperature Range | T_{STG} | -65 | 150 | °C |

RECOMMENDED OPERATING CONDITIONS

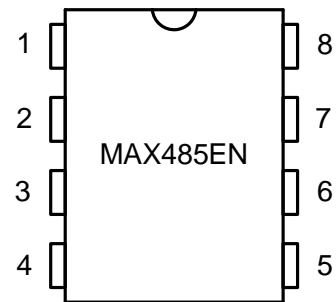
| Characteristic | Symbol | Min | Max | Unit |
|--------------------------------------|----------|------|------|------|
| Supply Voltage | V_{CC} | 4.75 | 5.25 | V |
| Operating Ambient Temperature Ranges | T_A | -40 | 85 | °C |

Low-Power, Slew-Rate-Limited RS-485/RS-422 Transceivers **MAX485**

PIN CONFIGURATION



SOP-8



DIP-8

PIN DESCRIPTION

| Pin No. | SOP-8 / DIP-8 PKG | |
|---------|-------------------|--|
| | Name | Function |
| 1 | RO | Receiver Output |
| 2 | RE* | Receiver Output Enable Active Low |
| 3 | DE | Driver Output Enable Active High |
| 4 | DI | Driver Input |
| 5 | GND | Ground |
| 6 | A | Non-inverting Driver Output and Receiver Input |
| 7 | B | Inverting Driver Output and Receiver Input |
| 8 | V _{CC} | Power Supply: 4.75V to 5.25V |

Low-Power, Slew-Rate-Limited RS-485/RS-422 Transceivers MAX485

ELECTRICAL CHARACTERISTICS

Unless otherwise specified: $V_{CC} = 5V \pm 5\%$, $T_A = T_{MIN}$ to T_{MAX}

| PARAMETER | Symbol | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|-----------------|--|----------------|-----|-----------|-----------|
| DRIVER DC Characteristics | | | | | | |
| Differential Driver Output (no load) | V_{OD1} | $R_L = \infty$, Figure 1 | GND | | V_{CC} | V |
| Differential Driver Output (with load) | V_{OD2} | $R_L = 50\Omega$ (RS-422), Figure 1 | 2 | | V_{CC} | V |
| | | $R_L = 27\Omega$ (RS-485), Figure 1 | 1.5 | | V_{CC} | |
| Change in Magnitude of Driver Differential Output Voltage for Complementary Output States | ΔV_{OD} | $R_L = 27\Omega$ or 50Ω , Figure 1 | | | 0.2 | V |
| Driver Common-Mode Output Voltage | V_{OC} | $R_L = 27\Omega$ or 50Ω , Figure 1 | | | 3 | V |
| Change in Magnitude of Driver Common-Mode Output Voltage for Complementary Output States | ΔV_{OC} | $R = 27\Omega$ or 50Ω , Figure 1 | | | 0.2 | V |
| Input High Voltage | V_{IH} | DE, DI, RE* | 2.0 | | | V |
| Input Low Voltage | V_{IL} | DE, DI, RE* | | | 0.8 | V |
| Input Current | I_{IN1} | DE, DI, RE* | | | ± 10 | μA |
| Driver Short Circuit Current | | | | | | |
| Driver Short-Circuit Current, $V_O = \text{High}$ | I_{OSD1} | $-7V \leq V_O \leq 12V$ | | | ± 250 | mA |
| Driver Short-Circuit Current, $V_O = \text{Low}$ | I_{OSD2} | $-7V \leq V_O \leq 12V$ | | | ± 250 | mA |
| DRIVER AC Characteristics | | | | | | |
| Max. Transmission Rate | f_{MAX} | | 5 | | | Mbps |
| Driver Input to Output | t_{DPLH} | Figure 3 & 5 $R_L = 54\Omega$, $C_{L1} = C_{L2} = 100pF$ | | 30 | 60 | ns |
| | t_{DPHL} | | | 30 | 60 | ns |
| Driver Output Skew to Output | t_{SKEW} | | | 5 | 10 | ns |
| Driver Rise or Fall Time | t_r, t_f | | | 15 | 40 | ns |
| Driver Enable to Output High | t_{ZH} | | S_2 closed | | 40 | 70 |
| Driver Enable to Output Low | t_{ZL} | S_1 closed | | 40 | 70 | ns |
| Driver Disable Time from Low | t_{HZ} | $C_L = 100pF$, S_2 closed | | 40 | 70 | ns |
| Driver Disable Time from High | t_{LZ} | $C_L = 100pF$, S_1 closed | | 40 | 70 | ns |
| RECEIVER DC Characteristics | | | | | | |
| Receiver Differential Threshold Voltage | V_{TH} | $-7V \leq V_{CM} \leq 12V$ | -0.2 | | 0.2 | V |
| Receiver Input Hysteresis | ΔV_{TH} | $V_{CM} = 0V$ | | 20 | | mV |
| Receiver Output High Voltage | V_{OH} | $I_O = -4mA$, $V_{ID} = +200mV$ | 3.5 | | | V |
| Receiver Output Low Voltage | V_{OL} | $I_O = +4mA$, $V_{ID} = -200mV$ | | | 0.4 | V |
| Three-State (High Impedance) Output Current at Receiver | I_{OZR} | $0.4V \leq V_O \leq 2.4V$, $RE^* = 5V$ | | | ± 1 | μA |
| Receiver Input Resistance | R_{IN} | $-7V \leq V_{CM} \leq 12V$ | 12 | 15 | | $k\Omega$ |
| Input Current (A, B) | I_{IN2} | $DE = 0V$, $V_{CC} = 0V$ or $5.25V$ | $V_{IN} = 12V$ | | 1.0 | mA |
| | | | $V_{IN} = -7V$ | | -0.8 | |
| Receiver Short-Circuit Current | I_{OSR} | $0V \leq V_O \leq V_{CC}$ | 7 | | 95 | mA |

Low-Power, Slew-Rate-Limited RS-485/RS-422 Transceivers **MAX485**

| RECEIVER AC Characteristics | | | | | | | |
|--|------------------|---|-----------------------|----|-----|-----|----|
| Receiver Input to Output | t _{PLH} | Figure 2 & 7 S ₁ , S ₂ open C _L = 15pF | | 20 | 45 | 100 | ns |
| | t _{PHL} | | | 20 | 45 | 100 | ns |
| t _{PLH} - t _{PHL} Differential Receiver Skew | t _{SKD} | | | | | 13 | |
| Receiver Enable to Output Low | t _{ZL} | Figure 2 & 8 C _L = 15pF | S ₁ closed | | 45 | 70 | ns |
| Receiver Enable to Output High | t _{ZH} | | S ₂ closed | | 45 | 70 | ns |
| Receiver Disable Time from Low | t _{LZ} | | S ₁ closed | | 45 | 70 | ns |
| Receiver Disable Time from High | t _{HZ} | | S ₂ closed | | 45 | 70 | ns |
| Supply Current | | | | | | | |
| No-Load Supply Current | I _{CC} | RE = 0V or V _{CC} | DE=V _{CC} | | 900 | | uA |
| | | | DE=0V | | 600 | | |

TEST CIRCUITS

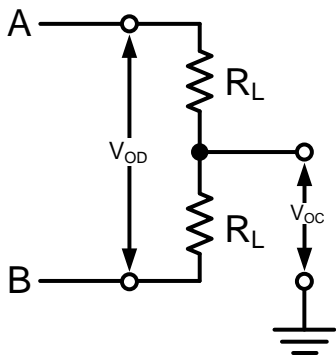


Figure 1.

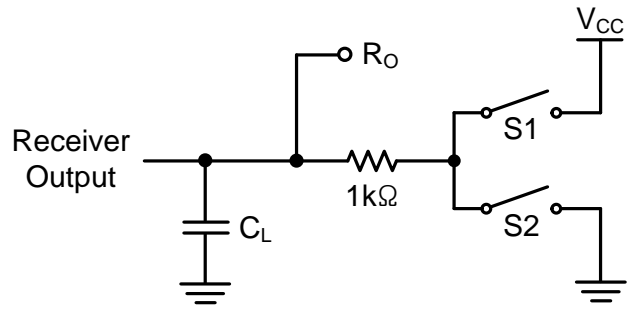


Figure 2.

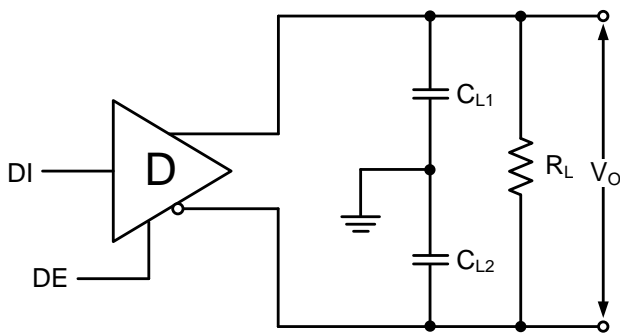


Figure 3.

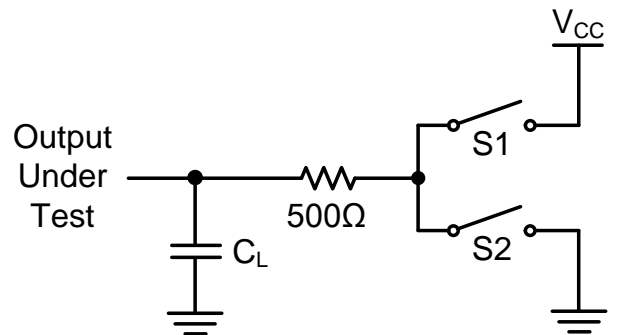


Figure 4.

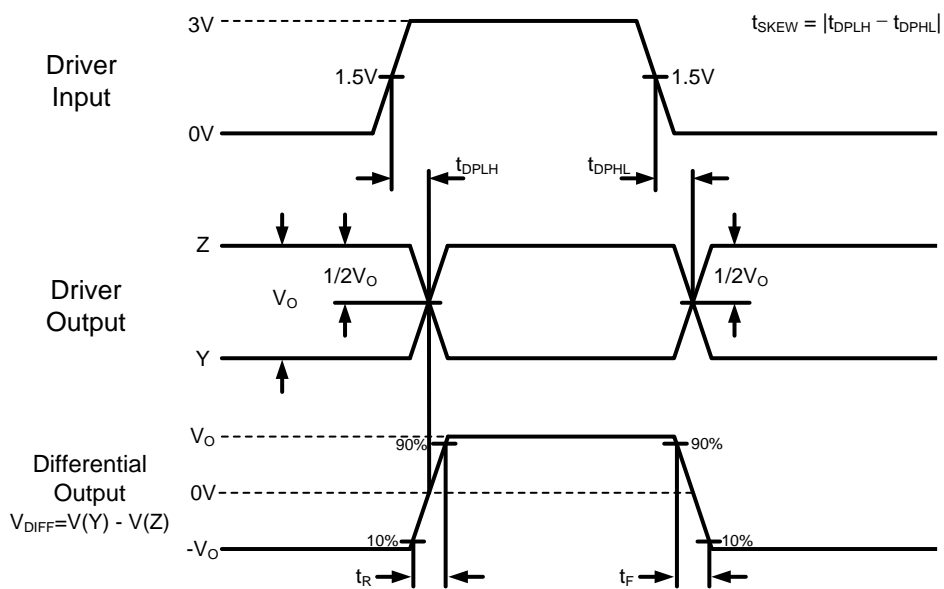


Figure 5.

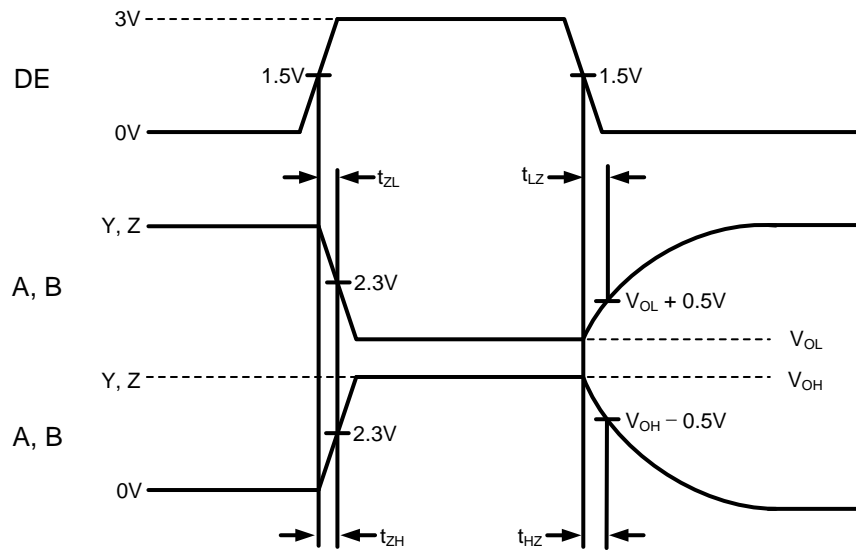


Figure 6.

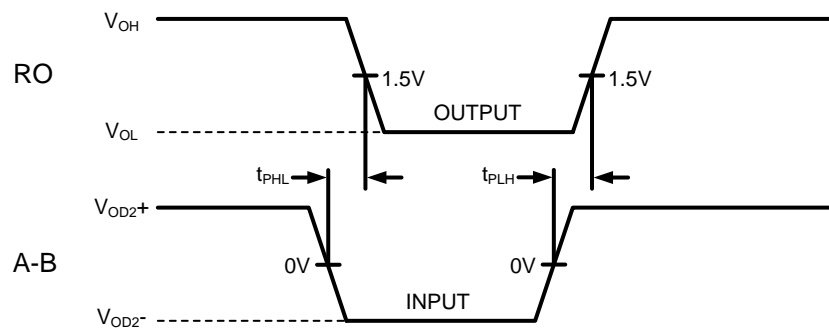


Figure 7.

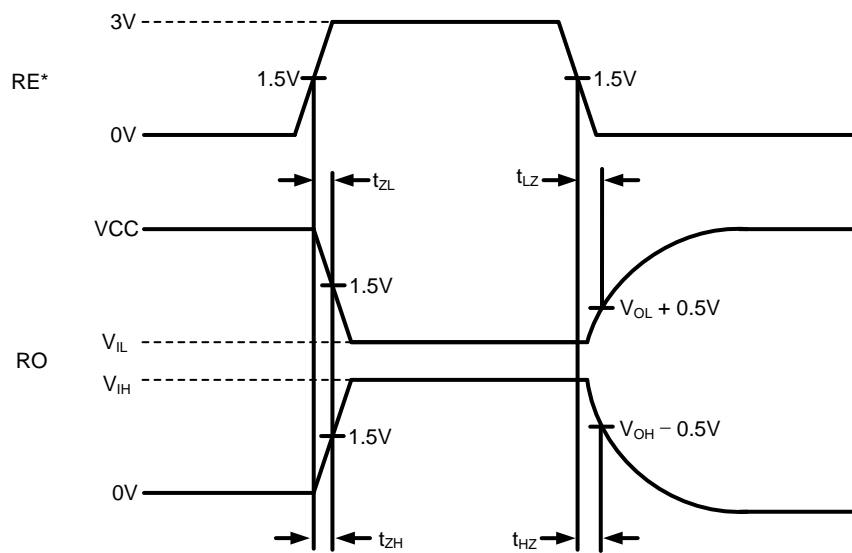


Figure 8.

APPLICATION INFORMATION

FUNCTIONAL DESCRIPTION

The MAX485 is half-duplex differential transceiver that meets the requirements of RS-485 and RS-422. The RS-485 standard is ideal for multi-drop applications and for long-distance interfaces. RS-485 allows up to 32 drivers and 32 receivers to be connected to a data bus, making it an ideal choice for multi-drop applications. Since the cabling can be as long as 4,000 feet, RS-485 transceivers are equipped with a wide (-7V to +12V) common mode range to accommodate ground potential differences. Because RS-485 is a differential interface, data is virtually immune to noise in the transmission line.

DRIVERS

The driver outputs of the MAX485 are differential outputs meeting the RS-485 and RS-422 standards. The typical voltage output swing with no load will be 0 Volts to +5 Volts. With worst case loading of 54 Ω across the differential outputs, the drivers can maintain greater than 1.5V voltage levels. The drivers of the MAX485 have an enable control line which is active HIGH. A logic HIGH on DE (pin 3) will enable the differential driver outputs. A logic LOW on the DE(pin 3) will tri-state the driver output. The transmitters of the MAX485 will operate up to at least 5Mbps.

RECEIVERS

The MAX485 receiver has differential inputs with an input sensitivity as low as $\pm 200\text{mV}$. Input impedance of the receivers is typically 15k Ω (12k Ω minimum). A wide common mode range of -7V to +12V allows for large ground potential differences between systems. The receivers of the MAX485 have a tri-state enable control pin. A logic LOW on RE* (pin 2) will enable the receiver, a logic HIGH on RE*(pin 2) will disable the receiver. The receiver for the MAX485 will operate up to at least 5Mbps. The receiver is equipped with the fail-safe feature. Fail-safe guarantees that the receiver output will be in a HIGH state when the input is left unconnected.

Low-Power, Slew-Rate-Limited RS-485/RS-422 Transceivers MAX485

REVISION NOTICE

The description in this datasheet can be revised without any notice to describe its electrical characteristics properly.