

FEATURES

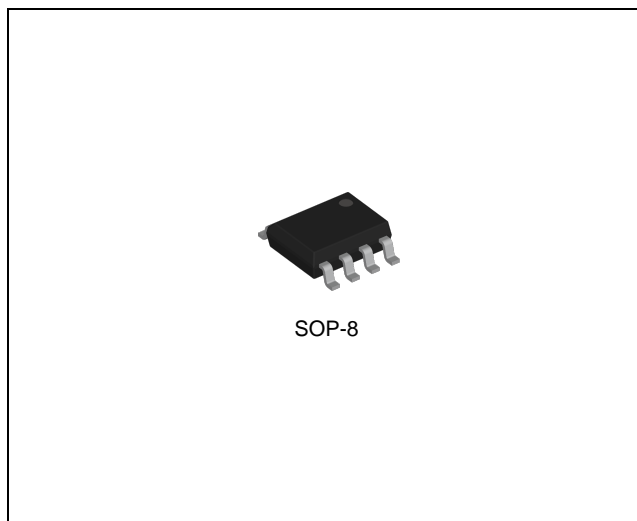
- Operates from a Single 3.3V Supply
- Interoperable with +5.0V Logic
- -7V to 12V Common-Mode Input Voltage Range
- Three-State Outputs
- Driver/ Receiver Enable
- Half-Duplex Communication
- Allows up to 32 Transceivers on the Bus
- Data Rate up to 10 Mbps
- Current-Limiting and Thermal Shutdown for Driver
Overload Protection
- ESD Specifications
 - ±15kV IEC61000-4-2 Air Discharge
 - ±8kV Human Body Model

APPLICATIONS

- Low Power RS-485 Systems
- Telecommunications
- Packet Switching
- Industrial-Control Local Area Networks
- Data Concentration
- Data Multiplexers
- Integrated Services Digital Network (ISDN)

DESCRIPTION

The MAX3485 is a low-power half-duplex transceiver that meets the specifications of RS-485 and RS-422. IC contains one driver and one receiver. The driver slew rates is not limited, allowing them to transmit up to 10Mbps. These transceivers draw between 120µA and 500µA of supply current when unloaded or fully loaded with disabled drivers. All parts operate from a single 3.3V supply. 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 ESD tolerance is more than ±8kV for both Human Body Model and ±15kV for IEC61000-4-2 Air Discharge Method on this device.



ORDERING INFORMATION

Device	Package
MAX3485ED	SOP-8

ABSOLUTE MAXIMUM RATINGS (Note 1)

CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Supply Voltage	V_{CC}	-0.3	6.0	V
Control Input Voltage	V_{RE}, V_{DE}	-0.3	6.0	V
Driver Input Voltage	V_{DI}	-0.3	6.0	V
Driver Output Voltage	V_A, V_B	-15	15	V
Receiver Input Voltage	V_A, V_B	-15	15	V
Receiver Output Voltage	V_{RO}	-0.3	$V_{CC} + 0.3$	V
Junction Temperature Range	T_J	-40	125	°C
Storage Temperature Range	T_{STG}	-65	150	°C

Note 1. 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 under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS (Note 2)

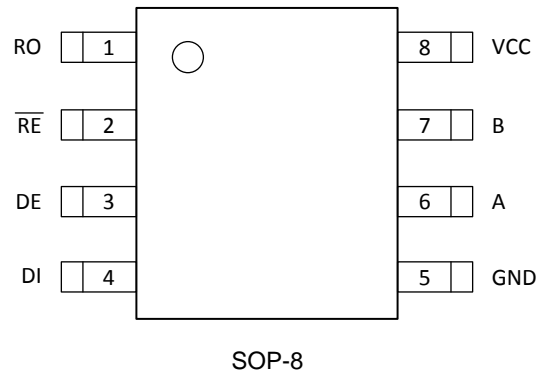
CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Supply Voltage	V_{CC}	0	$3.3 \pm 5\%$	V
Ambient Temperature Range	T_A	-40	85	°C

Note 2. The device is not guaranteed to function outside its operating ratings.

ORDERING INFORMATION

Package	Order No.	Description	Supplied As	Status
SOP-8	MAX3485ED	RS-485/ RS-422 Transceivers	Tape & Reel	Active

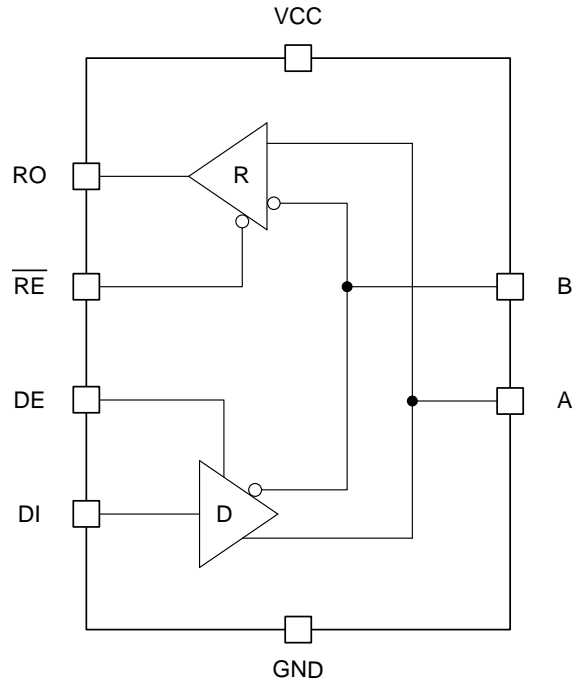
PIN CONFIGURATION



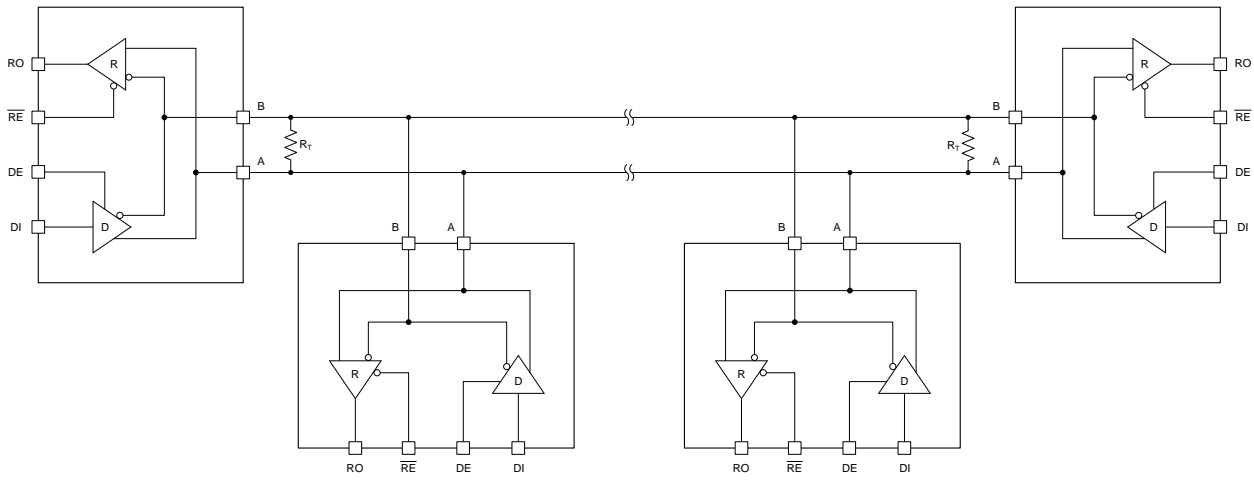
PIN DESCRIPTION

Pin No.	Pin Name	Pin Function
1	RO	Receiver Output
2	\overline{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/ Non-Inverting Receiver Input
7	B	Inverting Driver Output/ Inverting Receiver Input
8	VCC	Power Supply

BLOCK DIAGRAM



TYPICAL APPLICATION



< Typical RS-485 Network with Half-Duplex Transceivers >

DC ELECTRICAL CHARACTERISTICS

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Differential Output Voltage	V_{OD}	Unloaded, $R_L = \infty$, Figure 1	GND	-	V_{CC}	V	
		With Load, $R_L = 100\Omega$ (RS-422), Figure 1	1	-	V_{CC}		
		With Load, $R_L = 54\Omega$ (RS-485), Figure 1	0.6	-	V_{CC}		
Change in Magnitude of Driver Differential Output Voltage for Complimentary States (Note 3)	ΔV_{OD}	$R_L = 54\Omega$ or $R_L = 100\Omega$, Figure 1	-	-	0.2	V	
Driver Common- Mode Output Voltage	V_{OC}	$R_L = 54\Omega$ or $R_L = 100\Omega$, Figure 1	-	-	3.0	V	
Input High Voltage	V_{IH}	DE, DI, \overline{RE}	2.0	-	-	V	
Input Low Voltage	V_{IL}	DE, DI, \overline{RE}	-	-	0.6	V	
Logic Input Current	I_{IN1}	DE, DI, \overline{RE}	-	-	± 10	μA	
Driver Short-Circuit Output Current	I_{OSD}	$V_{OUT} = \text{High or Low, } -7V \leq V_{OUT} \leq 12V$	-	-	± 250	mA	
Receiver Differential Input Threshold	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}	$I_{OUT} = -1.5mA$, $V_{ID} = 200mV$, Figure 2	$V_{CC} - 0.4$	-	-	V	
Receiver Output Low Voltage	V_{OL}	$I_{OUT} = 2.5mA$, $V_{ID} = 200mV$, Figure 2	-	-	0.4	V	
Three-State (High Impedance) Output Current at Receiver	I_{OZR}	$0 \leq V_{OUT} \leq V_{CC}$, $\overline{RE} = V_{CC}$	-	-	± 1.0	μA	
Receiver Input Resistance	R_{IN}	$-7V \leq V_{CM} \leq 12V$	12	15	-	k Ω	
Receiver Input Current (A, B)	I_{IN2}	DE = 0V, $V_{CC} = 0V$ or 3.6V	$V_{IN} = 12V$	-	-	1.0	mA
			$V_{IN} = -7V$	-	-	-0.8	mA
Receiver Short Circuit Output Current	I_{OSR}	$0V \leq V_{OUTR} \leq V_{CC}$	7	-	60	mA	
Supply Current	I_{CC}	No Load, DI = 0V or V_{CC}	DE = V_{CC} , $\overline{RE} = 0V$ or V_{CC}	-	425	2000	μA
			DE = 0V, $\overline{RE} = 0V$	-	300	1500	

Note 3. ΔV_{OD} and ΔV_{OC} are the changes in V_{OD} and V_{OC} , respectively, when the DI input changes state.

AC ELECTRICAL CHARACTERISTICS

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Maximum Data Rate		$DE = \overline{RE} = V_{CC}$ or $0V$	10	-	-	Mbps
Driver Differential Output Transition Time	t_{TD}	Figure 3	-	5	20	ns
Driver Input to Output Propagation Delay, Low-to-High Level	t_{PLH}	Figure 4	-	17	60	ns
Driver Input to Output Propagation Delay, High-to-Low Level	t_{PHL}	Figure 4	-	17	60	ns
Driver Propagation Delay Skew	t_{SKEW}	Figure 4, $ t_{PLH} - t_{PHL} $	-	2	10	ns
Driver Output Enable Time to High	t_{PZH}	Figure 5	-	35	120	ns
Driver Output Enable Time to Low	t_{PZL}	Figure 6	-	30	120	ns
Driver Output Disable Time from High	t_{PHZ}	Figure 5	-	20	120	ns
Driver Output Disable Time from Low	t_{PLZ}	Figure 6	-	20	120	ns
Receiver Input to Output Propagation Delay, Low-to-High Level	t_{RPLH}	Figure 7	-	40	100	ns
Receiver Input to Output Propagation Delay, High-to-Low Level	t_{RPHL}	Figure 7	-	35	100	ns
Differential Receiver Propagation Delay Skew	t_{RSKEW}	Figure 7, $ t_{RPLH} - t_{RPHL} $	-	4	-	ns
Receiver Output Enable Time to Low	t_{PRZL}	Figure 8	-	10	60	ns
Receiver Output Enable Time to High	t_{PRZH}	Figure 8	-	10	60	ns
Receiver Output Disable Time from Low	t_{PRLZ}	Figure 8	-	10	60	ns
Receiver Output Disable Time from High	t_{PRHZ}	Figure 8	-	10	60	ns

FUNCTION TABLE

Transmitting				
Inputs			Outputs	
\overline{RE}	DE	DI	B	A
X	1	1	0	1
X	1	0	1	0
0	0	X	Z	Z
1	0	X	Z	Z

Receiving			
Inputs			Output
\overline{RE}	DE	A - B	RO
0	0	$\geq +0.2V$	1
0	0	$\leq -0.2V$	0
0	0	Inputs Open	1
1	0	X	Z

X: Don't Care Z: High Impedance

PARAMETER MEASUREMENT INFORMATION

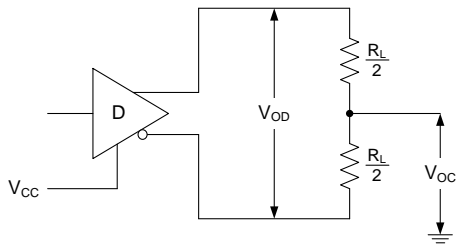


Fig. 1. Driver V_{OD} and V_{OC}

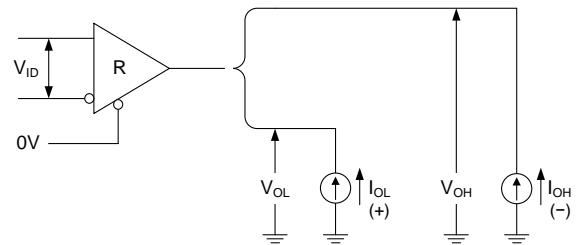


Fig. 2. Receiver V_{OH} and V_{OL}

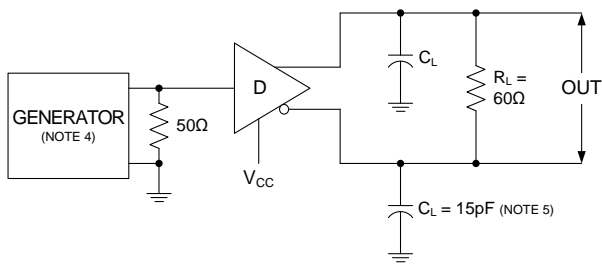
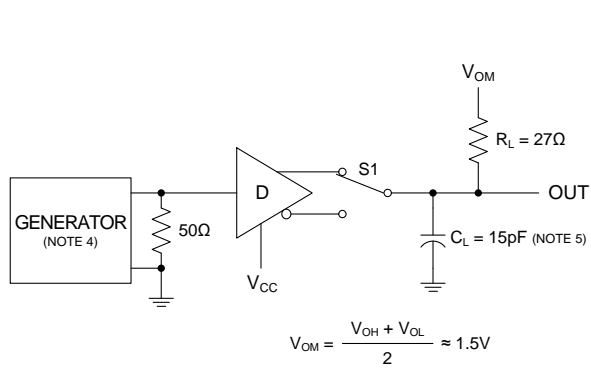
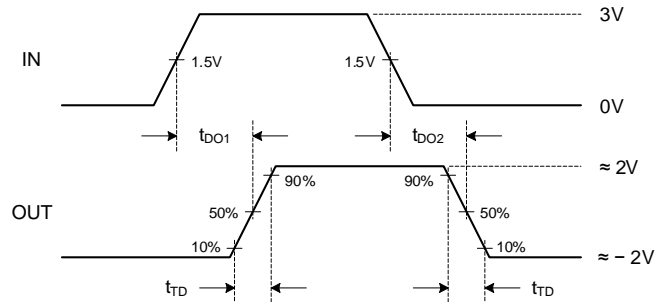


Fig. 3. Driver Differential Output Delay and Transition Times



$$V_{OM} = \frac{V_{OH} + V_{OL}}{2} \approx 1.5V$$

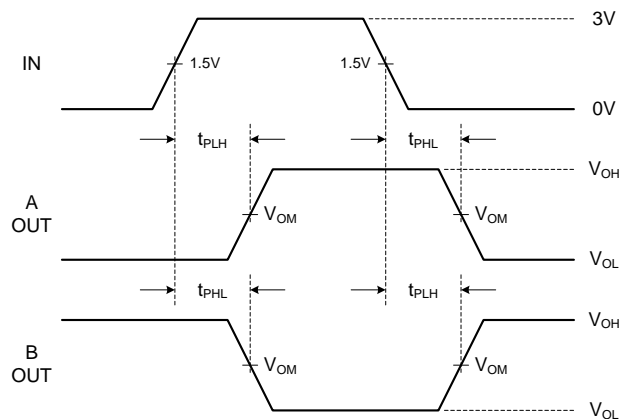


Fig. 4. Driver Propagation Delay

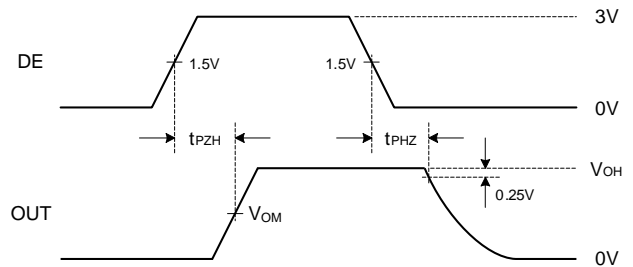
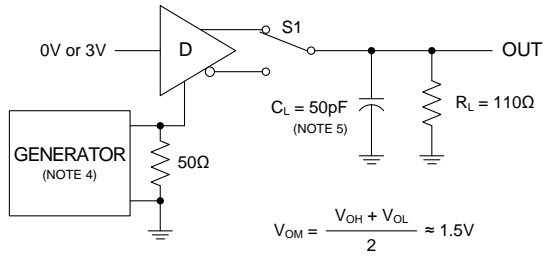


Fig. 5. Driver Enable and Disable Times, Output High

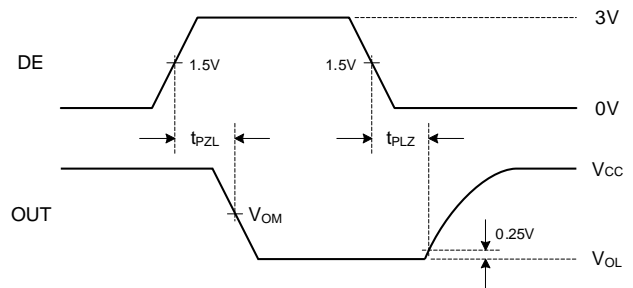
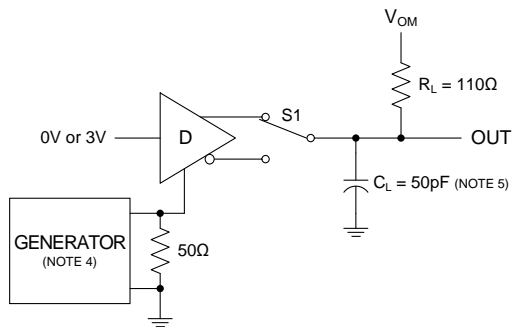


Fig. 6. Driver Enable and Disable Times, Output Low

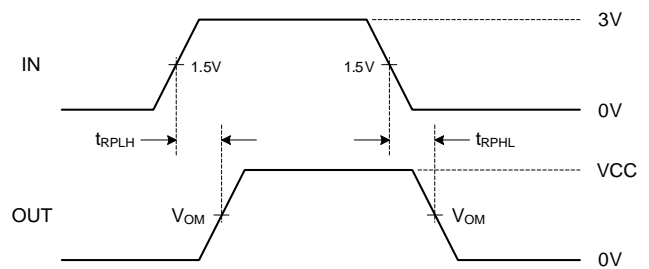
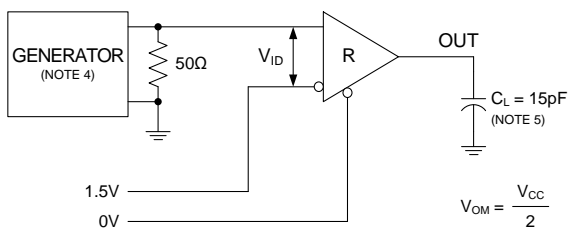


Fig. 7. Receiver Propagation Delay

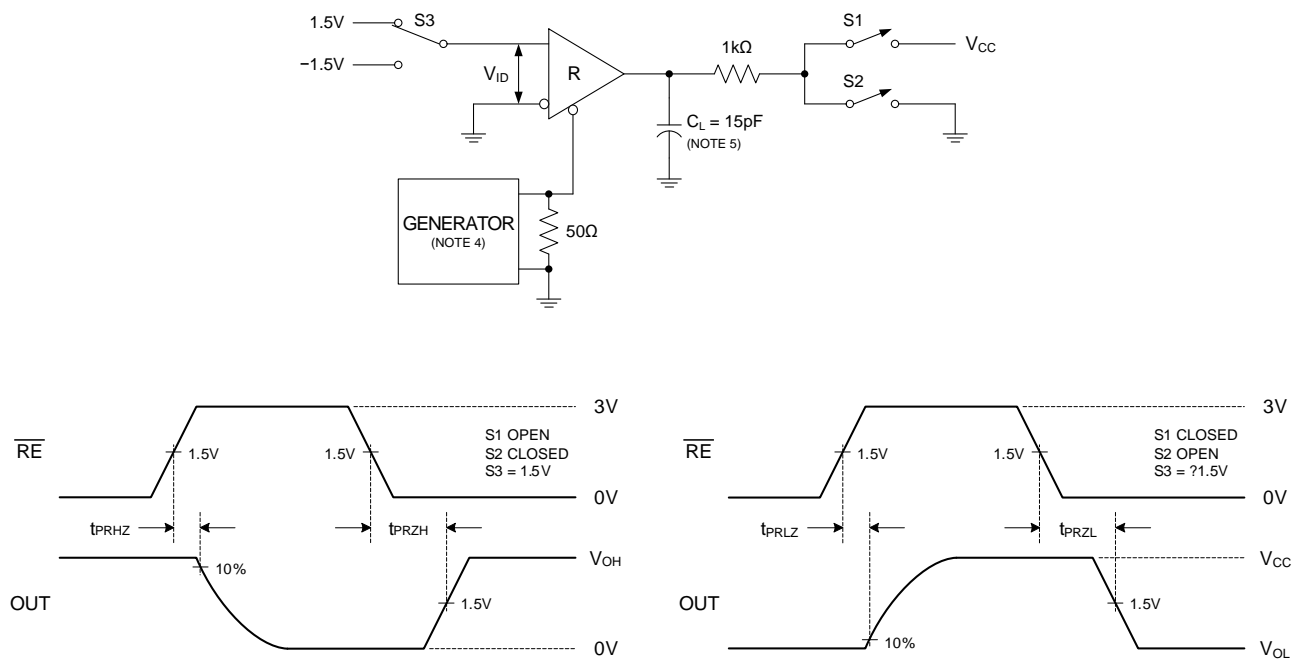


Fig. 8. Receiver Enable and Disable Times

Note 4. The input pulse is supplied by a generator with the following characteristics: PRR = 250kHz, 50% duty cycle, $t_r \leq 6.0\text{ns}$, $Z_o = 50\Omega$.

Note 5. C_L includes probe and stray capacitance.

APPLICATION INFORMATION

Functional Description

The MAX3485 is 3.3V low power 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 common mode range of -7V to 12V to accommodate ground potential differences. Because RS-485 is a differential interface, data is virtually immune to noise in the transmission line.

Output Enable

The receiver output RO is enabled when \overline{RE} is low. RO is high impedance when \overline{RE} is high.

The driver outputs are enabled by bringing DE high. They are high impedance when DE is low. If the driver outputs are enabled, the parts function as line drivers. While they are high impedance, they function as line receivers if \overline{RE} is low.

Driver

The driver outputs of the MAX3485 are differential outputs meeting the RS-485 and RS-422 standards. The typical voltage output swing with no load will be 0 Volts to 3.3 Volts. The driver of the MAX3485 has 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 DE (pin 3) will tri-state the driver outputs. The transmitter of the MAX3485 will operate up to 10Mbps.

Receiver

The MAX3485 receiver has differential inputs with an input sensitivity as low as $\pm 200\text{mV}$. Input impedance of the receiver is typically $15\text{k}\Omega$ ($12\text{k}\Omega$ minimum). A wide common mode range of -7V to +12V allows for large ground potential differences between systems. The receiver of the MAX3485 has a tri-state enable control pin. A logic low on \overline{RE} (pin 2) will enable the receiver, a logic high on \overline{RE} (pin 2) will disable the receiver. The receiver for the MAX3485 will operate up to 10Mbps. The receiver is equipped with the fail-safe feature. Fail-safe feature guarantees that the receiver output will be in a high state when the input is left unconnected.

REVISION NOTICE

The description in this datasheet is subject to change without any notice to describe its electrical characteristics properly.