19-1312; Rev 1; 3/06

MAXIM

Software-Selectable, Half-/Full-Duplex, Slew-Rate-Limited, 12Mbps, RS-485/RS-422 Transceivers in µMAX Package

General Description

The MAX1481/MAX1484/MAX1485/MAX1486 provide software-selectable, half-/full-duplex, low-power, slew-rate-limited, and high-speed (12Mbps) RS-485/RS-422 operation in a 10-pin µMAX® package—the smallest 10-pin package available.

The software-selectable, half-/full-duplex MAX1485/MAX1486 make obsolete the normally larger and more expensive solutions required for selectable half-/full-duplex RS-485/RS-422 operation: 1) a 14-pin, full-duplex transceiver configured via jumpers between receiver and transmitter lines, or 2) two 8-pin, half-duplex transceivers, which require an additional inverter logic gate for software selectability.

The MAX1481/MAX1484 are functionally equivalent to the industry-standard MAX491 and 75180, and are designed for space-constrained, full-duplex RS-422 applications.

All parts contain one driver and one receiver and feature a 1/8-unit-load receiver input impedance, allowing up to 256 transceivers on the bus. The MAX1481/MAX1485 feature reduced-slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free data transmission up to 250kbps. The MAX1484/MAX1486 driver slew rates are not limited, allowing them to transmit up to 12Mbps.

The MAX1481/MAX1484/MAX1485/MAX1486 draw only 300µA of supply current. The MAX1481 has a low-power shutdown mode that reduces supply current to only 0.1µA. All devices operate from a single 5V supply.

Drivers are output 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.

Features

- ♦ **10-Pin µMAX Package: Smallest 10-Pin Package**
- ♦ **Software-Selectable Half-/Full-Duplex Operation (MAX1485/MAX1486)**
- ♦ **0.1µA Low-Current Shutdown Mode (MAX1481)**
- ♦ **Slew-Rate Limiting Allows Error-Free Data Transmission (MAX1481/MAX1485)**
- ♦ **12Mbps High-Speed Operation (MAX1484/MAX1486)**
- ♦ **Allow up to 256 Transceivers on the Bus**

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX1481CUB	0°C to +70°C	10 µMAX
MAX1481EUB	-40°C to +85°C	10 µMAX
MAX1484CUB	0°C to +70°C	10 µMAX
MAX1484EUB	-40°C to +85°C	10 µMAX
MAX1485CUB	0°C to +70°C	10 µMAX
MAX1485EUB	-40°C to +85°C	10 µMAX
MAX1486CUB	0°C to +70°C	10 µMAX
MAX1486EUB	-40°C to +85°C	10 µMAX

Applications

Low-Power RS-422/RS-485 Communications

Level Translators

Hand-Held Equipment

Battery-Powered Equipment

Transceiver for EMI-Sensitive Applications

Industrial-Control Local Area Networks

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Selection Table

Part	Half/Full Duplex	Data Rate (Mbps)	Slew-Rate Limited	Low-Power Shutdown	Driver Enable	Receiver Enable	Quiescent Current (µA)	Transceivers on Bus	Pin-Package
MAX1481	Full	0.250	Yes	Yes	Yes	Yes	300	256	10 µMAX
MAX1484	Full	12	No	No	Yes	Yes	300	256	10 µMAX
MAX1485	Selectable	0.250	Yes	No	Yes	No	300	256	10 µMAX
MAX1486	Selectable	12	No	No	Yes	No	300	256	10 µMAX

For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

Software-Selectable, Half-/Full-Duplex, Slew-Rate-Limited, 12Mbps, RS-485/RS-422 Transceivers in µMAX Package

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_{CC}) .....+7V
Control Input Voltage ($\overline{RE}$, DE, H/$\overline{F}$) .....-0.3V to (V_{CC} + 0.3V)
Driver Input Voltage (DI).....-0.3V to (V_{CC} + 0.3V)
Driver Output Voltage (A, B, Y, Z) .....-8V to +12.5V
Receiver Input Voltage, Half Duplex (Y, Z) .....-8V to +12.5V
Receiver Input Voltage, Full Duplex (A, B).....-8V to +12.5V
Receiver Output Voltage (RO).....-0.3V to (V_{CC} + 0.3V)

Continuous Power Dissipation
10-Pin µMAX (derate 5.6mW/°C above +70°C) 444mW
Operating Temperature Ranges
MAX148_C_ _ .....0°C to +70°C
MAX148_E_ _.....-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

(V_{CC} = +5V ±5%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5V and T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
DRIVER							
Differential Driver Output	V_{OD1}	No load, Figure 5				5	V
	V_{OD2}	R = 50Ω (RS-422), Figure 5		2.0			
		R = 27Ω (RS-485), Figure 5		1.5		5	
Change in Magnitude of Differential Output Voltage (Note 2)	ΔV_{OD}	R = 50Ω or 27Ω, Figure 5				0.2	V
Driver Common-Mode Output Voltage	V_{OC}	R = 50Ω or 27Ω, Figure 5				3	V
Change in Magnitude of Common-Mode Voltage (Note 2)	ΔV_{OC}	R = 50Ω or 27Ω, Figure 5				0.2	V
Input High Voltage	V_{IH1}	DE, DI, $\overline{RE}$, H/$\overline{F}$		2.0			V
Input Low Voltage	V_{IL1}	DE, DI, $\overline{RE}$, H/$\overline{F}$				0.8	V
Input Current	I_{IN1}	DE, DI, $\overline{RE}$, H/$\overline{F}$				±2	µA
Input Current (Y and Z for Half Duplex, A and B for Full Duplex)	I_{IN2}	DE = GND, V_{CC} = GND or 5.25V	V_{IN} = 12V			0.125	mA
			V_{IN} = -7V			-0.1	
Output Leakage (Y and Z) (MAX1481/MAX1484 Only)	I_O	DE = GND	V_{IN} = 12V			10	µA
			V_{IN} = -7V			-10	
Output Leakage (Y and Z) (MAX1485/MAX1486 Only)	I_O	DE = GND	V_{IN} = 12V			125	µA
			V_{IN} = -7V			-100	
Driver Output Short-Circuit Current (Note 3)	I_{OSD}	-7V ≤ V_{OUT} ≤ 12V		35		250	mA

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +5V ±5%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5V and T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
RECEIVER						
Receiver Differential Threshold Voltage	V_{TH}	-7V ≤ V_{CM} ≤ 12V	-200		200	mV
Receiver Input Hysteresis	ΔV_{TH}			70		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 Output Current at Receiver	I_{OZR}	0.4V ≤ V_O ≤ 2.4V			±1	µA
Receiver Input Resistance	R_{IN}	-7V ≤ V_{CM} ≤ 12V	96			kΩ
Receiver Output Short-Circuit Current	I_{OSR}	0V ≤ V_{RO} ≤ V_{CC}			±95	mA
SUPPLY CURRENT						
No-Load Supply Current	I_{CC}	$\overline{RE}$ = GND, DE = V_{CC}		300	600	µA
Supply Current in Shutdown Mode (MAX1481 Only)	I_{SHDN}	DE = GND, $\overline{RE}$ = V_{CC}		0.1	10	µA

SWITCHING CHARACTERISTICS (MAX1484/MAX1486)

(V_{CC} = 5V ±5%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5V and T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Driver Input to Output	t_{DPLH}	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF, Figures 7 and 9		30	60	ns
	t_{DPHL}			30	60	
Driver Output Skew | t_{DPLH} - t_{DPHL} |	t_{DSKEW}	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF, Figures 7 and 9		5	10	ns
Driver Rise or Fall Time	t_{DR}, t_{DF}	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF, Figures 7 and 9	5	15	35	ns
Maximum Data Rate	f_{MAX}		12			Mbps
Driver Enable to Output Low	t_{DZL}	C_L = 100pF, S1 closed, Figures 8 and 10		40	70	ns
Driver Enable to Output High	t_{DZH}	C_L = 100pF, S2 closed, Figures 8 and 10		40	70	ns
Driver Disable Time from Low	t_{DLZ}	C_L = 15pF, S1 closed, Figures 8 and 10		40	70	ns
Driver Disable Time from High	t_{DHZ}	C_L = 15pF, S2 closed, Figures 8 and 10		40	70	ns
Receiver Input to Output	t_{RPLH}, t_{RPHL}	Figures 11 and 13		90	150	ns
| t_{RPLH} - t_{RPHL} | Differential Receiver Skew	t_{RSKD}	Figures 11 and 13		5		ns
Receiver Enable to Output Low	t_{RZL}	C_L = 100pF, S1 closed, Figures 6 and 12		20	50	ns
Receiver Enable to Output High	t_{RZH}	C_L = 100pF, S2 closed, Figures 6 and 12		20	50	ns
Receiver Disable Time from Low	t_{RLZ}	C_L = 100pF, S1 closed, Figures 6 and 12		20	50	ns
Receiver Disable Time from High	t_{RHZ}	C_L = 100pF, S2 closed, Figures 6 and 12		20	50	ns

SWITCHING CHARACTERISTICS (MAX1481/MAX1485) (continued)

(V_{CC} = 5V ±5%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5V and T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Driver Input to Output	t_{DPLH}	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF, Figures 7 and 9		600	1000	ns
	t_{DPHL}			600	1000	
Driver Output Skew | t_{DPLH} - t_{DPHL} |	t_{DSKEW}	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF, Figures 7 and 9		10	200	ns
Driver Rise or Fall Time	t_{DR}, t_{DF}	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF, Figures 7 and 9	250		1000	ns
Maximum Data Rate	f_{MAX}		250			kbps
Driver Enable to Output Low	t_{DZL}	C_L = 100pF, S1 closed, Figures 8 and 10			3000	ns
Driver Enable to Output High	t_{DZH}	C_L = 100pF, S2 closed, Figures 8 and 10			3000	ns
Driver Disable Time from Low	t_{DLZ}	C_L = 15pF, S1 closed, Figures 8 and 10			200	ns
Driver Disable Time from High	t_{DHZ}	C_L = 15pF, S2 closed, Figures 8 and 10			200	ns
Receiver Input to Output	t_{RPLH}, t_{RPHL}	Figures 11 and 13		90	150	ns
| t_{RPLH} - t_{RPHL} | Differential Receiver Skew	t_{RSKD}	Figures 11 and 13		15		ns
Receiver Enable to Output Low	t_{RZL}	C_L = 100pF, S1 closed, Figures 6 and 12		20	50	ns
Receiver Enable to Output High	t_{RZH}	C_L = 100pF, S2 closed, Figures 6 and 12		20	50	ns
Receiver Disable Time from Low	t_{RLZ}	C_L = 100pF, S1 closed, Figures 6 and 12		20	50	ns
Receiver Disable Time from High	t_{RHZ}	C_L = 100pF, S2 closed, Figures 6 and 12		20	50	ns
Time to Shutdown	t_{SHDN}	MAX1481 only (Note 4)	50	200	600	ns
Driver Enable from Shutdown to Output High	$t_{DZH(SHDN)}$	MAX1481 only, C_L = 15pF, S2 closed, Figures 8 and 10			3000	ns
Driver Enable from Shutdown to Output Low	$t_{DZL(SHDN)}$	MAX1481 only, C_L = 15pF, S1 closed, Figures 8 and 10			3000	ns
Receiver Enable from Shutdown to Output High	$t_{RZH(SHDN)}$	MAX1481 only, C_L = 100pF, S2 closed, Figures 6 and 12			500	ns
Receiver Enable from Shutdown to Output Low	$t_{RZL(SHDN)}$	MAX1481 only, C_L = 100pF, S1 closed, Figures 6 and 12			1000	ns

Note 1: All currents into the device are positive; all currents out of the device are negative. All voltages are referenced to device ground unless otherwise noted.

Note 2: ΔV_{OD} and ΔV_{OC} are the changes in V_{OD} and V_{OC}, respectively, when the DI input changes state.

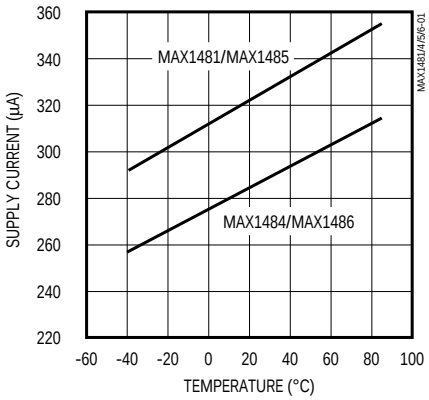
Note 3: Maximum current level applies to peak current just prior to foldback-current limiting; minimum current level applies during current limiting.

Note 4: Shutdown is enabled by bringing $\overline{RE}$ high and DE low. If the enable inputs are in this state for less than 50ns, the MAX1481 is guaranteed not to enter shutdown. If the enable inputs are in this state for at least 600ns, the MAX1481 is guaranteed to have entered shutdown.

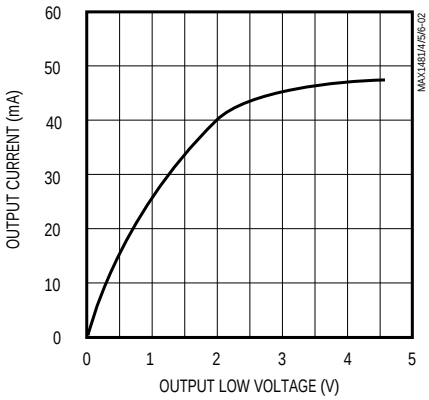
Typical Operating Characteristics

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

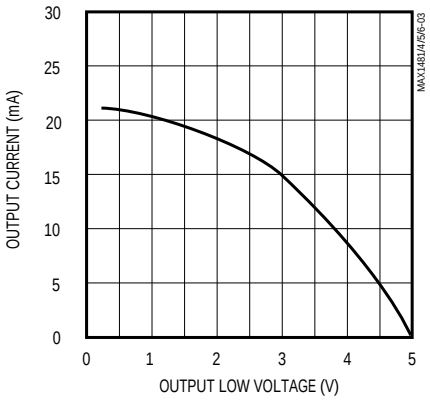
NO-LOAD SUPPLY CURRENT vs. TEMPERATURE



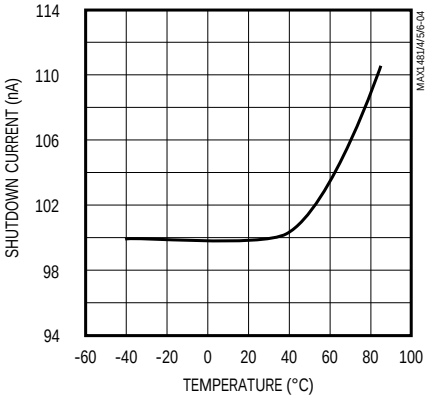
OUTPUT CURRENT vs. RECEIVER OUTPUT LOW VOLTAGE



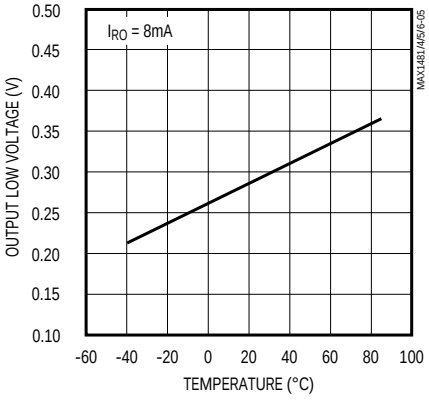
OUTPUT CURRENT vs. RECEIVER OUTPUT HIGH VOLTAGE



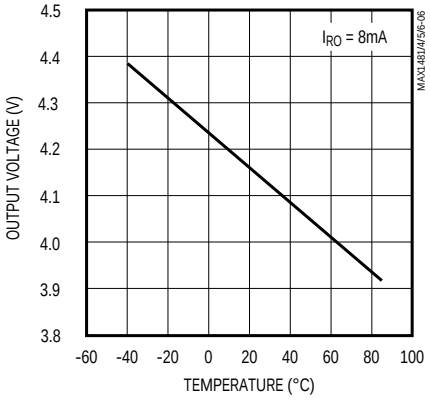
SHUTDOWN CURRENT vs. TEMPERATURE



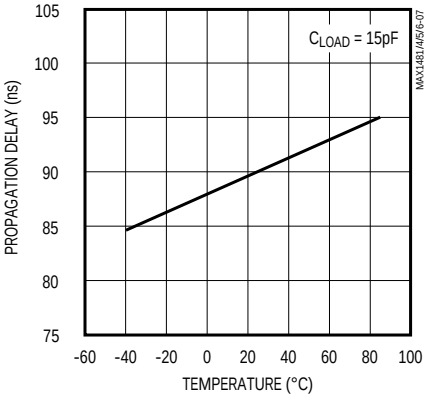
RECEIVER OUTPUT LOW VOLTAGE vs. TEMPERATURE



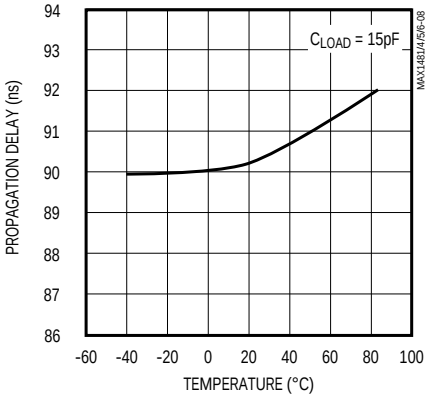
RECEIVER OUTPUT HIGH VOLTAGE vs. TEMPERATURE



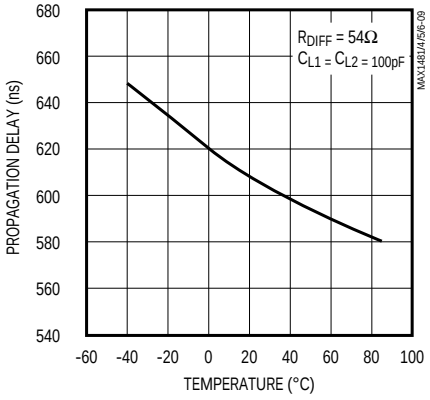
MAX1481/MAX1485 RECEIVER PROPAGATION DELAY vs. TEMPERATURE



MAX1484/MAX1486 RECEIVER PROPAGATION DELAY vs. TEMPERATURE



MAX1481/MAX1485 DRIVER PROPAGATION DELAY vs. TEMPERATURE

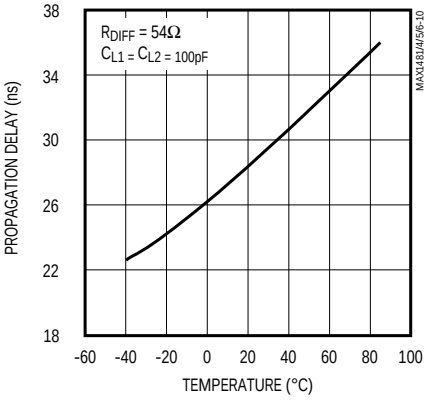


Software-Selectable, Half-/Full-Duplex, Slew-Rate-Limited, 12Mbps, RS-485/RS-422 Transceivers in µMAX Package

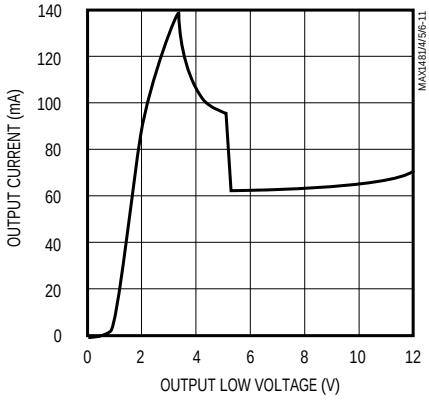
Typical Operating Characteristics (continued)

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

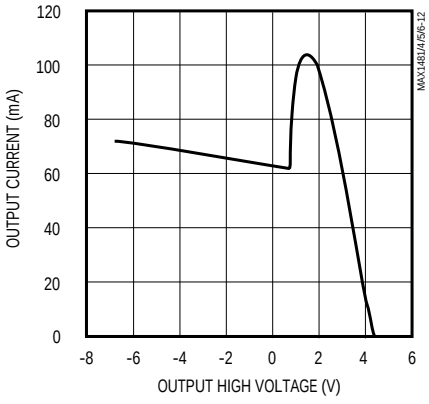
MAX1484/MAX1486 DRIVER PROPAGATION DELAY vs. TEMPERATURE



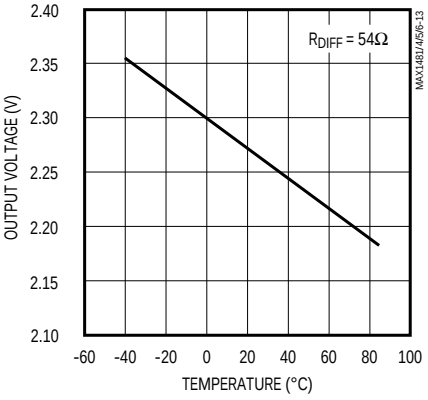
OUTPUT CURRENT vs. DRIVER OUTPUT LOW VOLTAGE



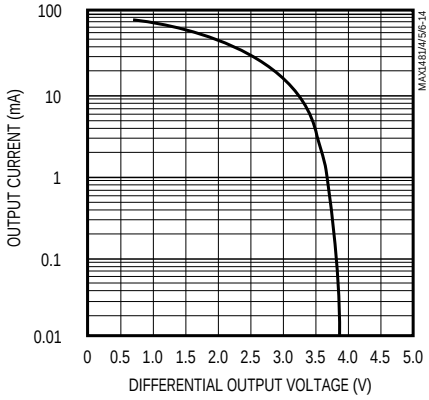
OUTPUT CURRENT vs. DRIVER OUTPUT HIGH VOLTAGE



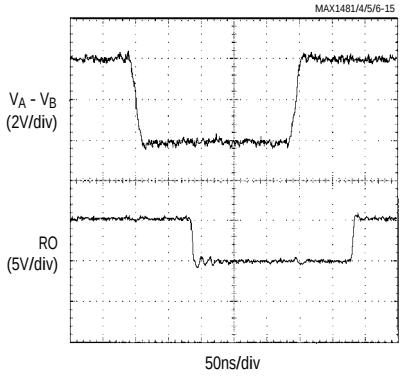
DRIVER DIFFERENTIAL OUTPUT VOLTAGE vs. TEMPERATURE



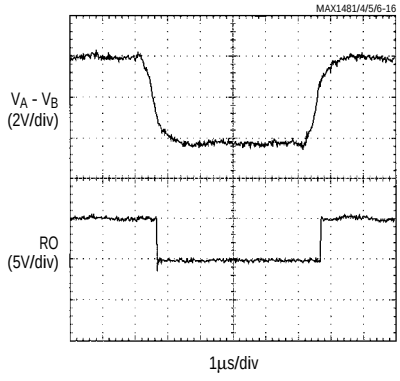
DRIVER OUTPUT CURRENT vs. DIFFERENTIAL OUTPUT VOLTAGE



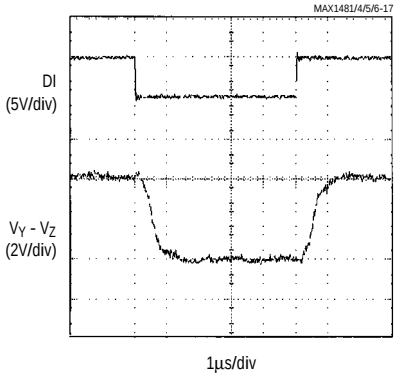
MAX1484/MAX1486 RECEIVER PROPAGATION DELAY



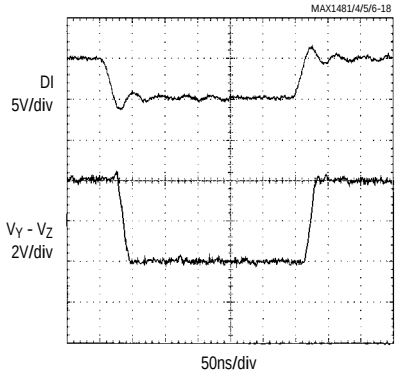
MAX1481/MAX1485 RECEIVER PROPAGATION DELAY



MAX1481/MAX1485 DRIVER PROPAGATION DELAY



MAX1484/MAX1486 DRIVER PROPAGATION DELAY



Pin Description

PIN			NAME	FUNCTION
MAX1481/ MAX1484	MAX1485/MAX1486			
	H/$\overline{F}$ = 0	H/$\overline{F}$ = 1		
1	1	1	RO	Receiver Output. When $\overline{RE}$ is low and if A - B ≥ 200mV, RO goes high; if A - B ≤ -200mV, RO goes low.
—	2	2	H/$\overline{F}$	Half-/Full-Duplex Selector Input. Connect H/$\overline{F}$ to V_{CC} for half-duplex mode, and connect to GND for full-duplex mode.
2	—	—	$\overline{RE}$	Receiver Output Enable Input. Drive $\overline{RE}$ low to enable RO; RO is high impedance when $\overline{RE}$ is high. For MAX1481 only, drive $\overline{RE}$ high and DE low to enter the low-power shutdown mode.
3	3	3	DE	Driver Output Enable Input. Drive DE high to enable driver outputs. These outputs are high impedance when DE is low.
4	4	4	DI	Driver Input. With DE high, a low on DI forces noninverting output low and inverting output high. Similarly, a high on DI forces noninverting output high and inverting output low.
5	5	5	GND	Ground
6	6	—	B	Inverting Receiver Input
—	—	6	B	Receiver Input Resistors*
7	7	—	Z	Inverting Driver Output
—	—	7	Z	Inverting Driver Output and Inverting Receiver Input
8	8	—	Y	Noninverting Driver Output
—	—	8	Y	Noninverting Driver Output and Noninverting Receiver Input
9	9	—	A	Noninverting Receiver Input
—	—	9	A	Receiver Input Resistors*
10	10	10	V_{CC}	Positive Supply; +4.75V ≤ V_{CC} ≤ +5.25V

**(MAX1485/MAX1486 only) In half-duplex mode, the driver outputs serve as receiver inputs. The full-duplex receiver inputs (A and B) will still have a 1/8-unit load, but are not connected to the receiver.*

Function Tables

MAX1481

TRANSMITTING				
INPUTS			OUTPUTS	
$\overline{RE}$	DE	DI	Z	Y
X	1	1	0	1
X	1	0	1	0
0	0	X	High-Z	High-Z
1	0	X	High-Z and Shutdown	

RECEIVING			
INPUTS			OUTPUT
$\overline{RE}$	DE	A-B	RO
0	X	≥ 0.2V	1
0	X	≤ -0.2V	0
1	1	X	High-Z
1	0	X	High-Z and Shutdown

MAX1484

TRANSMITTING				
INPUTS			OUTPUTS	
$\overline{RE}$	DE	DI	Z	Y
X	1	1	0	1
X	1	0	1	0
X	0	X	High-Z	High-Z

RECEIVING			
INPUTS			OUTPUT
$\overline{RE}$	DE	A-B	RO
0	X	≥ 0.2V	1
0	X	≤ -0.2V	0
1	X	X	High-Z

MAX1485/MAX1486

TRANSMITTING			
INPUTS		OUTPUTS	
DE	DI	Z	Y
1	1	0	1
1	0	1	0
0	X	High-Z	High-Z

RECEIVING				
INPUTS			OUTPUT	
H/$\overline{F}$	DE	A-B	Y-Z	RO
0	X	≥ 0.2V	X	1
0	X	≤ -0.2V	X	0
1	0	X	≥ 0.2V	1
1	0	X	≤ -0.2V	0

X = Don't care

Note: In shutdown mode, driver and receiver outputs are high impedance.

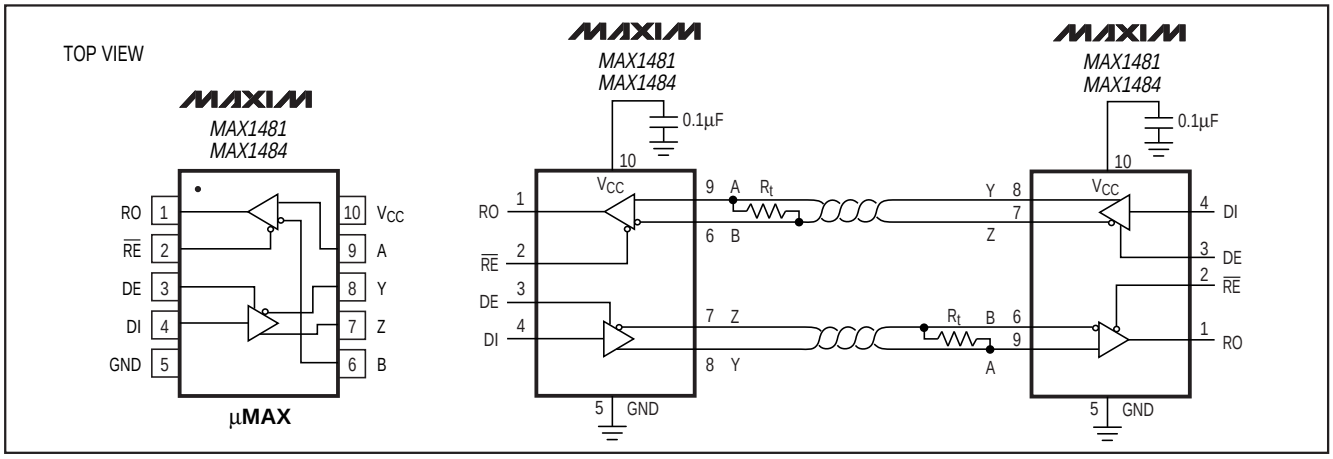


Figure 1. MAX1481/MAX1484 Pin Configuration and Typical Full-Duplex Operating Circuit

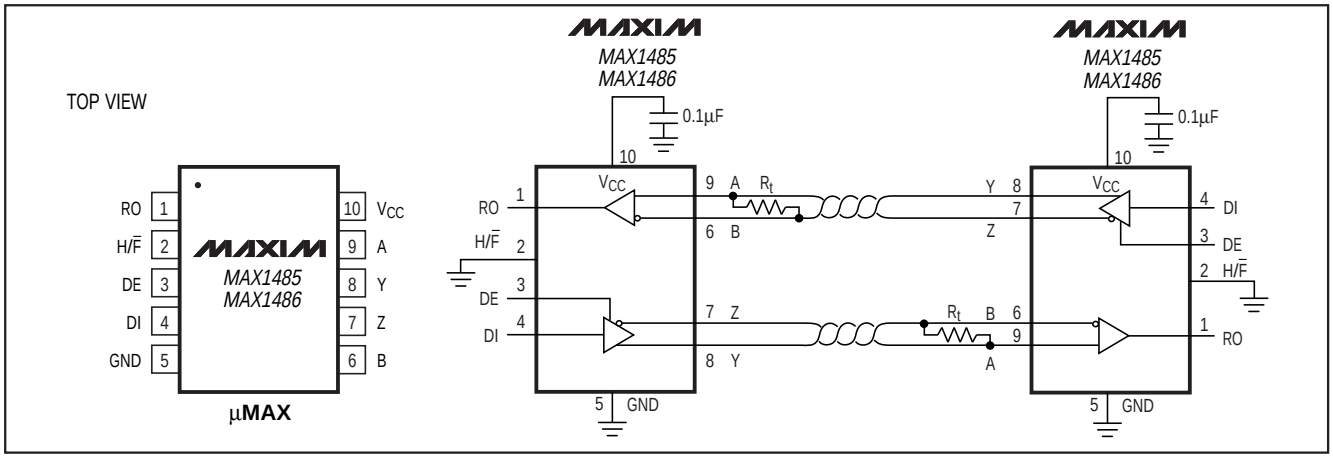


Figure 2. MAX1485/MAX1486 Pin Configuration and Equivalent Typical Full-Duplex Operating Circuit

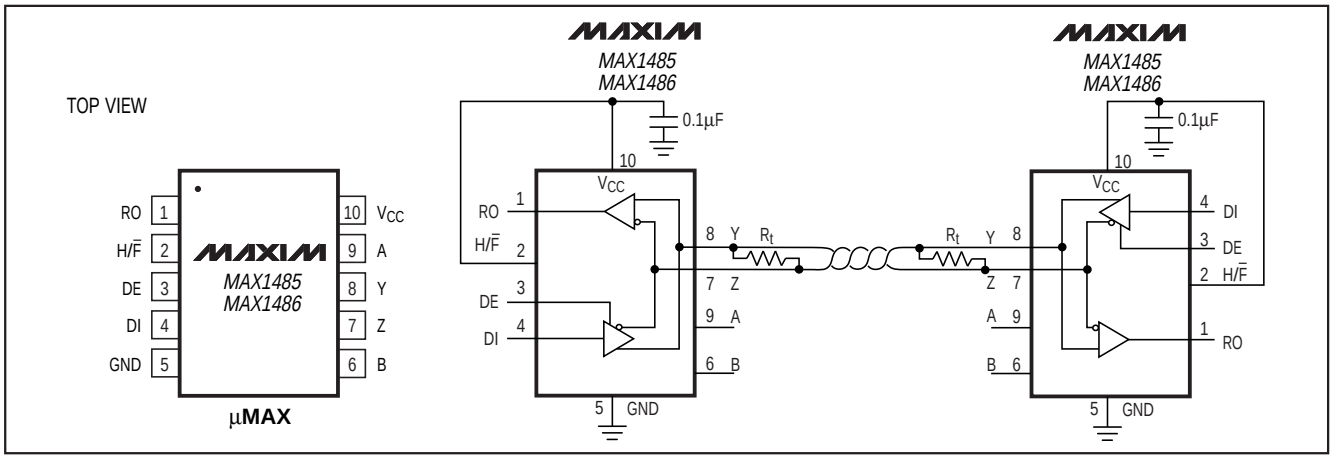


Figure 3. MAX1485/MAX1486 Pin Configuration and Equivalent Typical Half-Duplex Operating Circuit

Software-Selectable, Half-/Full-Duplex, Slew-Rate-Limited, 12Mbps, RS-485/RS-422 Transceivers in µMAX Package

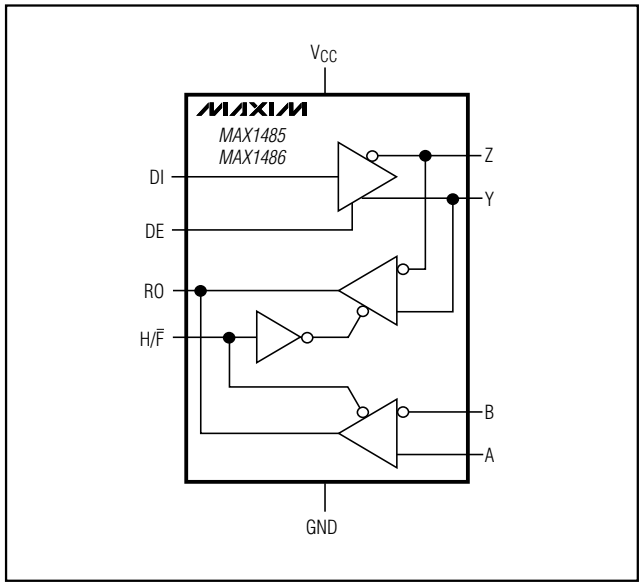


Figure 4. MAX1485/MAX1486 Functional Diagram

Detailed Description

The MAX1481/MAX1484/MAX1485/MAX1486 high-speed transceivers for RS-485/RS-422 communication contain one driver and one receiver. The MAX1481/MAX1485 feature reduced-slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free data transmission up to 250kbps. The MAX1484/MAX1486 driver slew rates are not limited, making transmission speeds up to 12Mbps possible.

These transceivers are designed to operate on a +5V single supply and typically draw 300µA of supply current when unloaded or fully loaded with the drivers disabled. The MAX1481 has a shutdown mode in which supply current is typically reduced to 0.1µA.

Drivers are output 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.

All devices have a 1/8-unit-load receiver input impedance that allows up to 256 transceivers on the bus. The MAX1481/MAX1484 are designed for full-duplex communications. The H/$\overline{F}$ pin on the MAX1485/MAX1486 allows the user to select between half-duplex or full-duplex operation (Figure 4).

MAX1485/MAX1486 Half-/Full-Duplex Mode Operation

The MAX1484/MAX1485 can operate in full- or half-duplex mode. Drive the H/$\overline{F}$ pin low or connect it to GND for full-duplex operation, or drive it high for half-duplex operation. In full-duplex mode, the pin configuration of the driver and receiver is the same as a MAX1481 (Figure 1).

Applications Information

256 Transceivers on the Bus

The standard RS-485 receiver input impedance is 12kΩ (1-unit load), and the standard driver can drive up to 32-unit loads. The MAX1481/MAX1484/MAX1485/MAX1486 transceivers have a 1/8-unit-load receiver input impedance (96kΩ), allowing up to 256 transceivers to be connected in parallel on one communication line. Connect any combination of these devices and/or other RS-485 transceivers totaling 32-unit loads or less.

Reduced EMI and Reflections

The MAX1481/MAX1485 are slew-rate limited, minimizing EMI and reducing reflections caused by improperly terminated cables. Figure 14 shows the driver output waveform and its Fourier analysis of a 20kHz signal transmitted by a MAX1484. High-frequency harmonic components with large amplitudes are evident. Figure 15 shows the same signal displayed for a MAX1481 transmitting under the same conditions. Figure 15's high-frequency harmonic components are much lower in amplitude compared to Figure 14's, significantly reducing potential EMI.

In general, a transmitter's rise time relates directly to the length of an unterminated stub, which can be driven with only minor waveform reflections. The following equation expresses this relationship conservatively:

$$\text{Length} = t_{RISE} / (10 \times 1.5\text{ns/ft})$$

where t_{RISE} is the transmitter's rise time.

For example, the MAX1481's rise time is typically 500ns, which results in excellent waveforms with a stub length up to 33 feet. A system may work well with longer unterminated stubs, even with severe reflections, if the waveform settles out before the UART samples them.

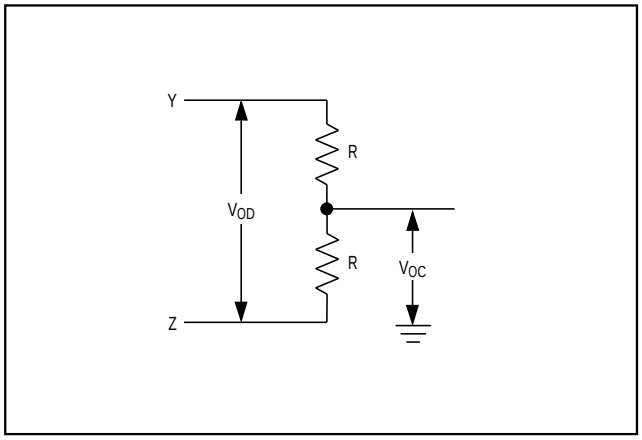


Figure 5. Driver DC Test Load

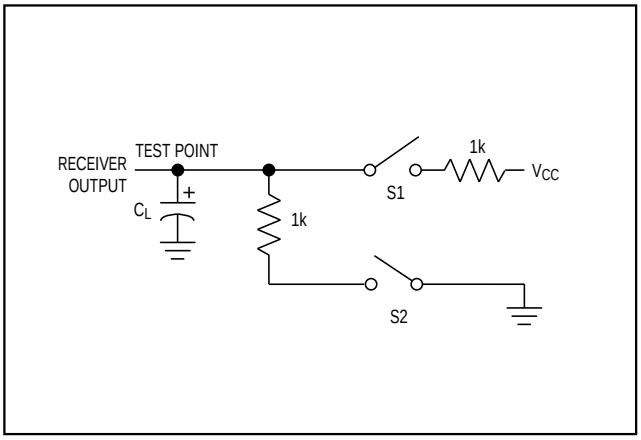


Figure 6. Receiver Enable/Disable Timing Test Load

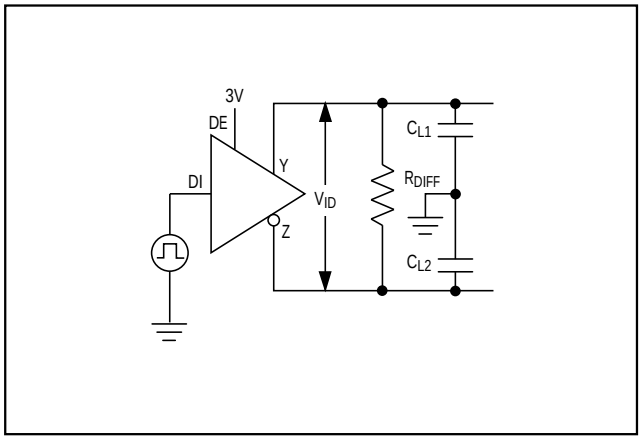


Figure 7. Driver Timing Test Circuit

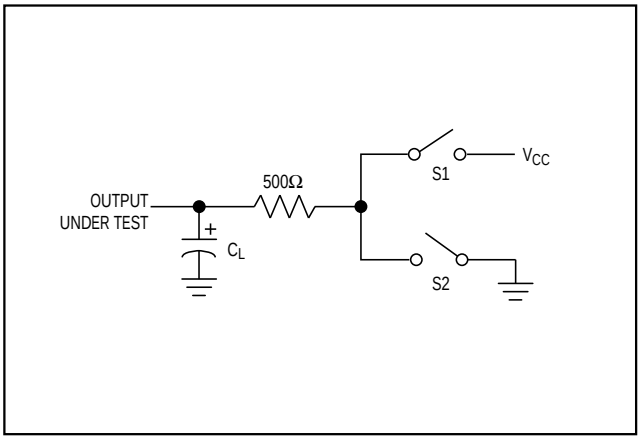


Figure 8. Driver Enable/Disable Timing Test Load

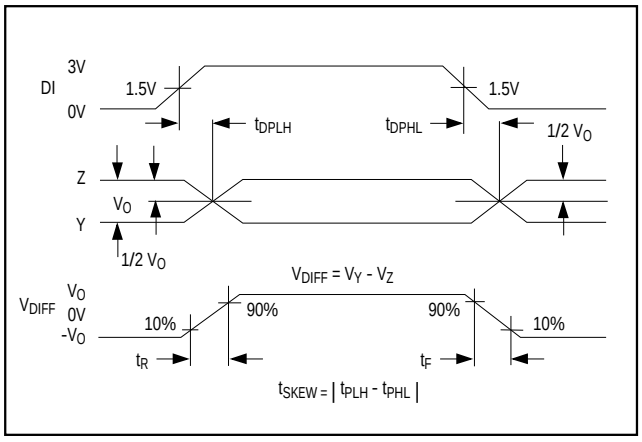


Figure 9. Driver Propagation Delays

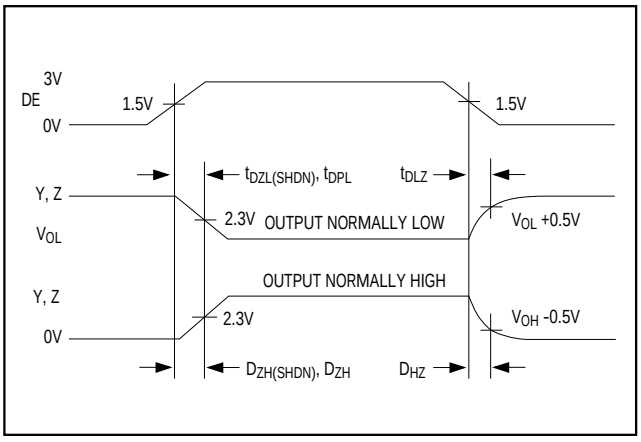


Figure 10. Driver Enable and Disable Times

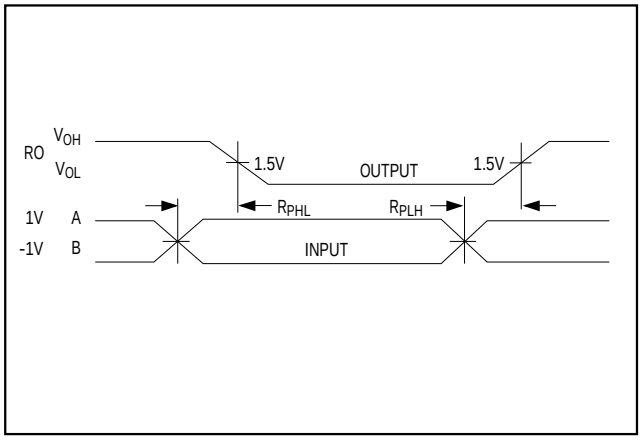


Figure 11. Receiver Propagation Delays

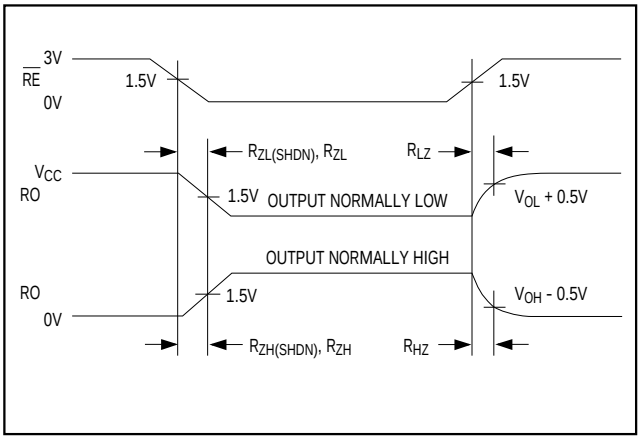


Figure 12. Receiver Enable and Disable Times (MAX1481/MAX1484 only)

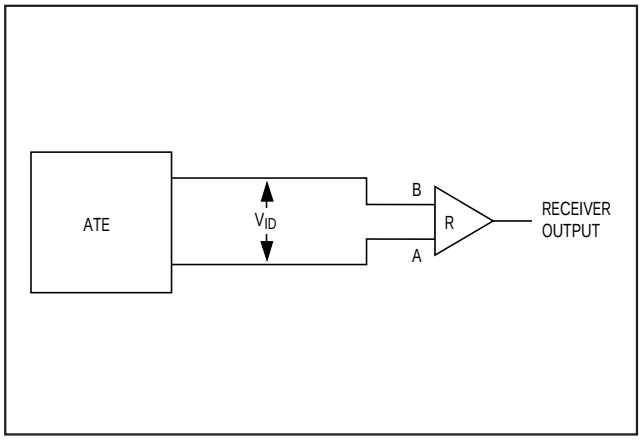


Figure 13. Receiver Propagation Delay Test Circuit

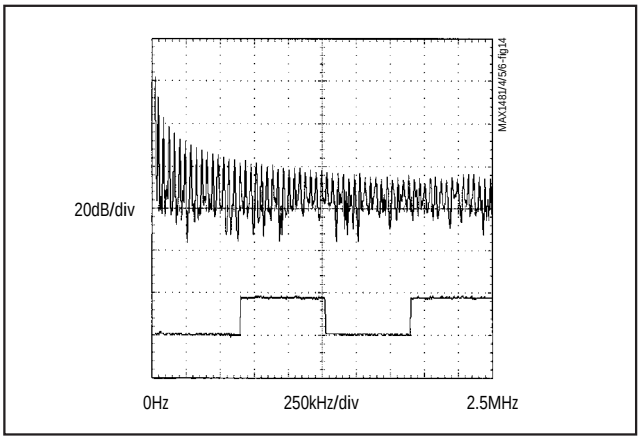


Figure 14. Driver Output Waveform and FFT Plot of MAX1484/MAX1486 Transmitting a 20kHz signal

Low-Power Shutdown Mode (MAX1481 only)

Low-power shutdown mode is initiated by bringing both $\overline{RE}$ high and DE low. In shutdown, the MAX1481 typically draws only 0.1µA of supply current.

$\overline{RE}$ and DE may be driven simultaneously; the parts are guaranteed not to enter shutdown if $\overline{RE}$ is high and DE is low for less than 50ns. If the inputs are in this state for at least 600ns, the parts are guaranteed to enter shutdown.

Enable times t_{ZH} and t_{ZL} in the *Switching Characteristics* tables assume the part was not in low-power shutdown. Enable times $t_{ZH(SHDN)}$ and $t_{ZL(SHDN)}$ assume the parts were shut down. It takes drivers and receivers longer to become enabled from the low-power shutdown mode ($t_{ZH(SHDN)}$, $t_{ZL(SHDN)}$) than from the driver/receiver disable mode (t_{ZH}, t_{ZL}).

Driver Output Protection

Excessive output current and power dissipation caused by faults or by bus contention are prevented by two mechanisms. 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 becomes excessive.

Line Length vs. Data Rate

The RS-485/RS-422 standard covers line lengths up to 4000 feet. For line lengths greater than 4000 feet, use the repeater application shown in Figure 16.

Figures 17 and 18 show the system differential voltage for the parts driving 4000 feet of 26AWG twisted-pair wire into 120Ω loads.

Typical Applications

The MAX1485/MAX1486 are designed for bidirectional data communications on multipoint bus transmission lines. Figures 19 and 20 show typical network applications circuits. These parts can also be used as line repeaters with cable lengths longer than 4000 feet (Figure 16).

To minimize reflections, terminate the line at both ends in its characteristic impedance, and keep stub lengths off the main line as short as possible. The slew-rate-limited MAX1481/MAX1485 are more tolerant of imperfect termination than the MAX1484/MAX1486.

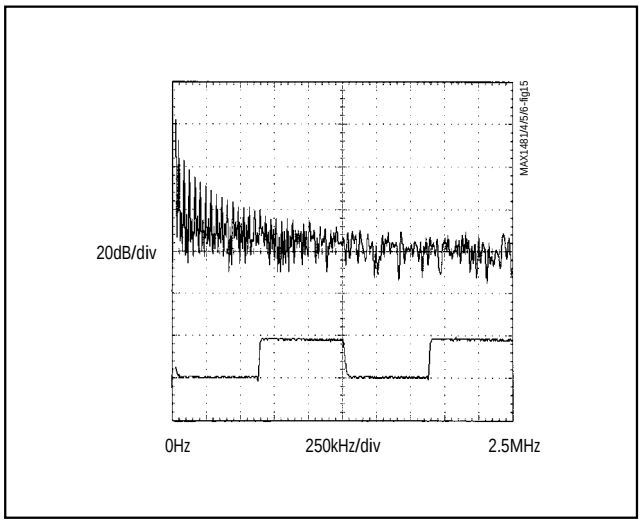


Figure 15. Driver Output Waveform and FFT Plot of MAX1481/MAX1485 Transmitting a 20kHz Signal

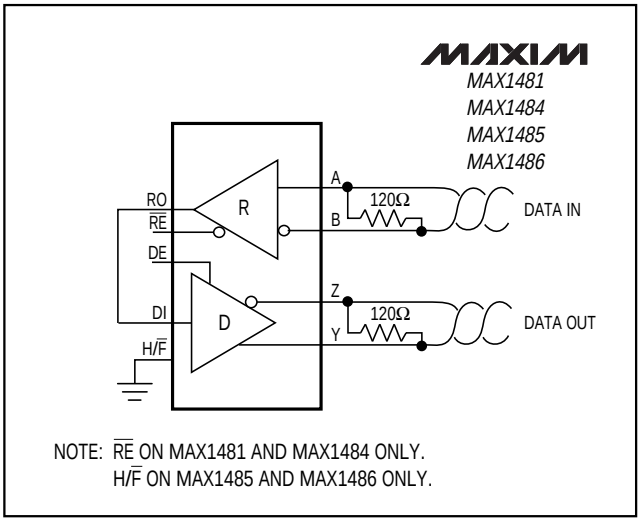


Figure 16. Line Repeater

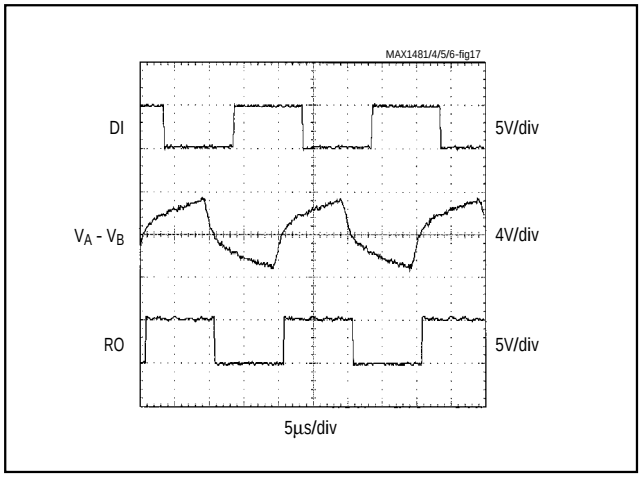


Figure 17. MAX1481/MAX1485 System Differential Voltage at 50kHz Driving 4000 ft. of Unterminated Cable

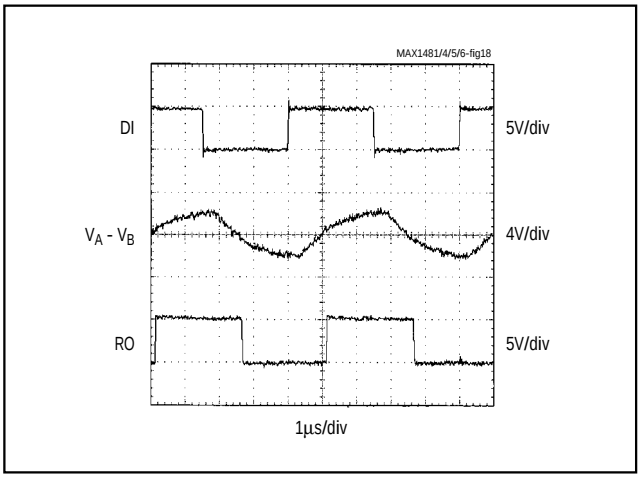


Figure 18. MAX1484/MAX1486 System Differential Voltage at 200kHz Driving 4000 ft. of Unterminated Cable

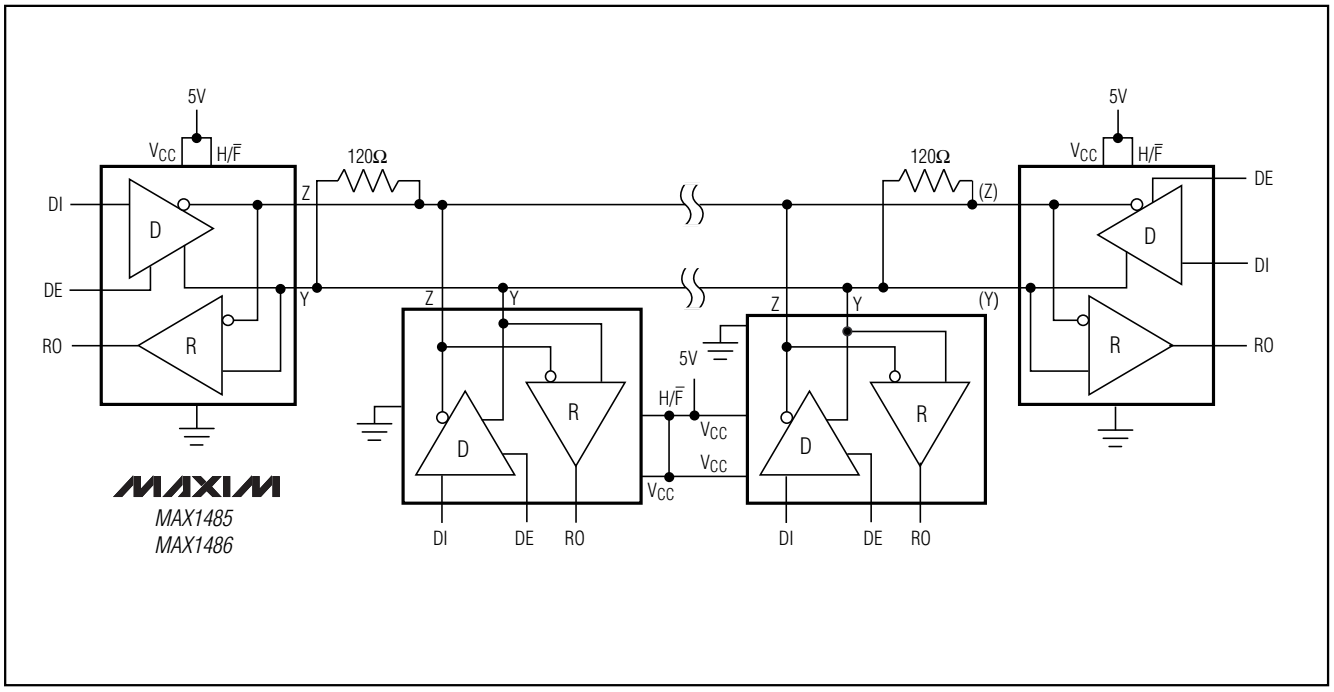


Figure 19. Typical Half-Duplex RS-485 Network

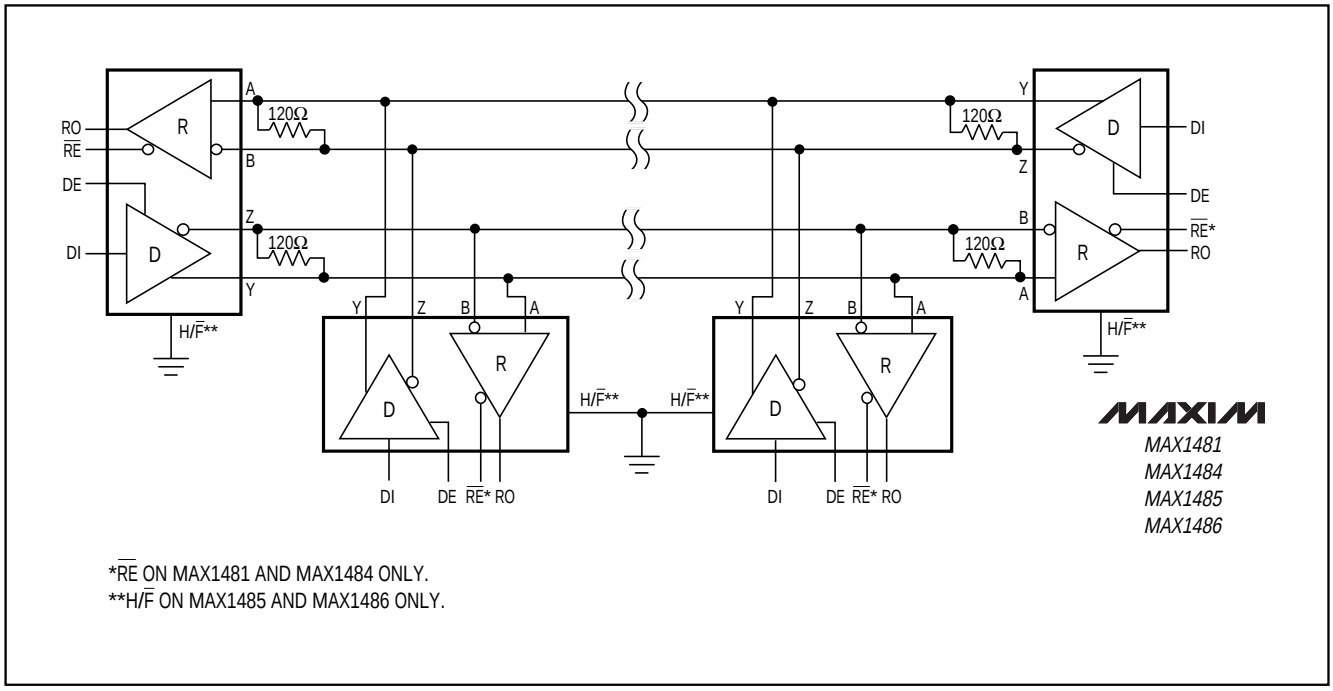


Figure 20. Typical Full-Duplex RS-485 Network

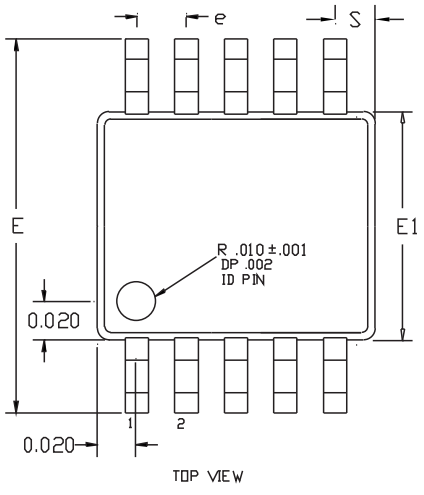
Chip Information

TRANSISTOR COUNT: 396

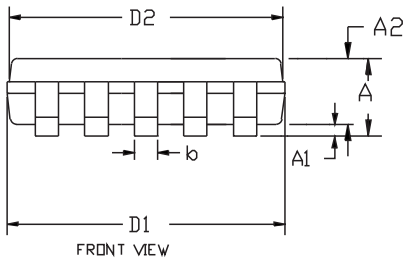
Package Information

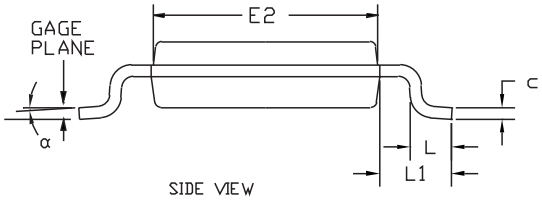
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)

10LUMAXB.EPS



	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.037	0.043	0.939	1.092
A1	0.002	0.006	0.051	0.152
A2	0.030	0.038	0.762	0.965
D1	0.112	0.124	2.845	3.150
D2	0.110	0.122	2.794	3.099
E1	0.112	0.124	2.845	3.150
E2	0.110	0.122	2.794	3.099
E	0.185	0.201	4.699	5.105
L	0.0155	0.0275	0.394	0.699
L1	0.037 REF		0.940 REF	
b	0.007	0.0106	0.177	0.270
e	0.0197 BSC		.500 BSC	
c	0.0035	0.0078	0.090	0.200
S	0.0196 REF		.498 REF	
α	0°	6°	0°	6°





NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm(.006").
3. CONTROLLING DIMENSION: INCHES

MAXIM
PROPRIETARY INFORMATION

TITLE:
PACKAGE OUTLINE, 10L MICRO MAX

APPROVAL	DOCUMENT CONTROL NO.	REV	
	21-0061	B	1/1

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