

## Applications

RS-422/RS-485 Communications  
 Level Translators  
 Transceivers for EMI-Sensitive Applications  
 Industrial-Control Local Area Networks

## General Description

The MAX3082/MAX3085/MAX3088 high-speed transceivers for RS-485/RS-422 communication contain one driver and one receiver. These devices feature fail-safe circuitry, which guarantees a logic-high receiver output when the receiver inputs are open or shorted. This means that the receiver output will be a logic high if all transmitters on a terminated bus are disabled

(high impedance). The MAX3082 feature reduced slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free data transmission up to 115kbps. The MAX3085 offer higher driver output slew-rate limits, allowing transmit speeds up to 500kbps. The MAX3088's driver slew rates are not limited, making transmit speeds up to 10Mbps possible. These transceiver typically draw 375µA of supply current when unloaded, or when fully loaded with the drivers disabled.

All devices have a 1/8-unit-load receiver input impedance that allows up to 256 transceivers on the bus. The MAX3082/MAX3085/MAX3088 are intended for half-duplex communications, while the MAX3082/MAX3085/MAX3088 are intended for half-duplex communications.

## Selection Table

Part	Half/Full Duplex	Data Rate (Mbps)	Slew Rate Limited	Low-Power Shutdown	Receiver/Driver Enable	Quiescent Current (µA)	Transceivers On Bus	Pin Count	Industry-Standard Pinout
MAX3082	Half	0.115	Yes	Yes	Yes	375	256	8	75176
MAX3085	Half	0.5	Yes	Yes	Yes	375	256	8	75176
MAX3088	Half	1.0	No	Yes	Yes	375	256	8	75176

\*Pin-compatible with 75180, with additional features implemented using pins 1,6,8, and 13.

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage(Vcc).....+7V  
 Control Input Voltage (RE, DE) .....-0.3V to (Vcc +0.3V)

### Special Input Voltage

(HIF, SRL, TXP, RXP).....-0.3V to (Vcc +0.3V)  
 Driver Input Voltage (DI).....-0.3V to (Vcc + 0.3V)  
 Driver Output Voltage (A, B, Y, Z).....±13V  
 Receiver Input Voltage(A, B).....±13V  
 Receiver Input Voltage, Full Duplex (A, B)..... ±25V  
 Receiver Output Voltage (RO).....-0.3V to (Vcc +0.3V)

## Continuous Power Dissipation

8-Pin Plastic DIP (derate 9.09 mW/ above +70 )...727mW  
 8-Pin SO (derate 5.88mW/ above +70 ).....471mW  
 14-Pin Plastic DIP (derate 10.0 mW/ above +70 )..800mW  
 14-Pin SO (derate 8.33 mW/ above +70 ).....667mW

## Operating Temperature Ranges

MAX308\_C.....0 to +70  
 MAX308\_E.....-40 to +85  
 Storage Temperature Range.....-65 to +150  
 Lead Temperature (soldering, 10s).....+300

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.

**DC ELECTRICAL CHARACTERISTICS**

 (V<sub>CC</sub> = +5V ±5%, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>CC</sub>=+5V and T<sub>A</sub> = +25 °C)(Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DRIVER</b>						
Differential Driver Output (no load)	V <sub>OD1</sub>	Figure 2			5	V
Differential Driver Output	V <sub>OD2</sub>	Figure 2, R=50Ω (RS-422)	2.0			V
		Figure 2, R=25Ω (RS-485)	1.5			
Change in Magnitude of Differential Output Voltage (Note 2)	V <sub>OD</sub>	Figure 2, R=50Ω or R=27Ω			0.2	V
Driver Common-Mode Output Voltage	V <sub>OC</sub>	Figure 2, R=50Ω or R=27Ω			3	V
Change In Magnitude of Common-Mode Voltage (Note2)	V <sub>OC</sub>	Figure 2, R=50Ω or R=27Ω			0.2	V
Input High Voltage	V <sub>IH1</sub>	DE, DI, $\overline{RE}$ , $\overline{HF}$ , TXP, RXP	2.0			V
Input Low Voltage	V <sub>IL1</sub>	DE, DI, $\overline{RE}$ , $\overline{HF}$ , TXP, RXP			0.8	V
DI Input Hysteresis	V <sub>HYS</sub>	MAX3082/MAX3085 with SRL= V <sub>CC</sub> or unconnected		100		mV
SRL Input Current	I <sub>IN1</sub>	DE, DI, $\overline{RE}$			±2	μA
	I <sub>IN2</sub>	$\overline{HF}$ , TXP, RXP, internal pulldown	10		40	
Input High Voltage	V <sub>IH2</sub>	SRL	V <sub>CC</sub> -0.8			V
Input Middle Voltage	V <sub>IM2</sub>	SRL (Note 3)	0.4V <sub>CC</sub>		0.6V <sub>CC</sub>	V
Input Low Voltage	V <sub>IL2</sub>	SRL			0.8	V
SRL Input Current	I <sub>IN3</sub>	SRL=V <sub>CC</sub>			75	μA
		SRL=GND (Note 3)	-75			
Input Current (A and B) Full Duplex	I <sub>IN4</sub>	DE=GND, V <sub>CC</sub> =GND or 5.25V	VIN=12v		125	μA
			VIN=-7v		-75	
Output Leakage (Y and Z) Full Duplex	I <sub>O</sub>	DE=GND, V <sub>CC</sub> =GND or 5.25V	VIN=12V		125	μA
			VIN=-7V	-100		
Driver Short-Circuit Output Current (Note 4)	V <sub>OD1</sub>	-7V ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub>	-250			mA
		0V ≤ V <sub>OUT</sub> ≤ 12V			250	
		0V ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub>	±25			
<b>RECEIVER</b>						
Receiver Differential Threshold Voltage	V <sub>TH</sub>	-7V ≤ V <sub>CM</sub> ≤ +12V	-200	-125	-50	mV
Receiver Input Hysteresis	V <sub>TH</sub>			25		mV
Receiver Output High Voltage	V <sub>OH</sub>	I <sub>O</sub> =-4mA, V <sub>ID</sub> = -50mV	V <sub>CC</sub> -1.5			V
Receiver Output Low Voltage	V <sub>OL</sub>	I <sub>O</sub> =4mA, V <sub>ID</sub> = -200mV			0.4	V
Three-State Output Current at Receiver	I <sub>OZR</sub>	0.4V ≤ V <sub>O</sub> ≤ 2.4V			±1	μA
Receiver Input Resistance	R <sub>IN</sub>	-7V ≤ V <sub>CM</sub> ≤ +12V	96			kΩ
Receiver Output Short-Circuit Current	I <sub>OSR</sub>	0V ≤ V <sub>RO</sub> ≤ V <sub>CC</sub>	±7		±95	mA
<b>SUPPLY CURRENT</b>						
Supply Current	I <sub>CC</sub>	No load, $\overline{RE}$ =DI=GND or V <sub>CC</sub> , SRL= V <sub>CC</sub>	DE=V <sub>CC</sub>	430	900	μA
			DE=GND	375	600	μA
		No load, $\overline{RE}$ =DI=GND or V <sub>CC</sub> , SRL= GND	DE=V <sub>CC</sub>	475	1000	μA
			DE=GND	420	800	μA
Supply Current in Shutdown Mode	I <sub>SHDN</sub>	DE=GND, $\overline{VRE}$ =V <sub>CC</sub>		0.001	10	μA

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

**Note 2:**  $\Delta V_{OD}$  and  $\Delta V_{OC}$  are the change in  $V_{OD}$  and  $V_{OC}$ , respectively, when the DI input changes state.

**Note 3:** The SRL pin is internally biased to  $V_{CC}/2$  by a 100k $\Omega$ /100k $\Omega$  resistor divider. It is guaranteed to be  $V_{CC}/2$  if left unconnected.

**Note 4:** Maximum current level applies to peak current just prior to foldback-current limiting; minimum current level applies during current limiting.

### SWITCHING CHARACTERISTICS- MAX3082 with SRL=Unconnected

( $V_{CC}=+5V \pm 5\%$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical value are at  $V_{CC}=+5V$  and  $T_A = +25^\circ C$ .)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Driver Input to Output	$t_{DPLH}$	Figures 4 and 6, $R_{DIFF}=54\Omega$ , $C_{L1}=C_{L2}=100pF$	500	2030	2600	ns
	$t_{DPHL}$		500	2030	2600	
Driver Output Skew   $t_{DPLH}-t_{DPHL}$	$t_{DSKEW}$	Figure 4 and 6, $R_{DIFF}=54\Omega$ , $C_{L1}=C_{L2}=100pF$		-3	$\pm 200$	ns
Driver Rise or Fall Time	$t_{DR}, t_{DF}$	Figures 4 and 6, $R_{DIFF}=54\Omega$ $C_{L1}=C_{L2}=100pF$	667	1320	2500	ns
Maximum Data Rate	$f_{MAX}$		115			Kbps
Driver Enable to Output High	$t_{DZH}$	Figures 5, $CL=100pF, S2$ closed			3500	ns
Driver Enable to Output Low	$t_{DZL}$	Figures 5, $CL=100pF, S1$ closed			3500	ns
Driver Disable Time from Low	$t_{DLZ}$	Figures 5, $CL=15pF, S1$ closed			100	ns
Driver Disable Time from High	$t_{DHZ}$	Figures 5, $CL=15pF, S2$ closed			100	ns
Receiver Input to Output	$t_{RPLH},$ $t_{RPHL}$	Figures 7 and 8; $ V_{ID}  \geq 2.0V$ ; Rise and fall time of $V_{ID} \leq 15ns$		127	200	ns
$t_{RPLH} - t_{RPHL}$   Differential Receiver Skew	$t_{RSKD}$	Figures 7 and 8; $ V_{ID}  \geq 2.0V$ ; Rise and fall time of $V_{ID} \leq 15ns$		3	$\pm 30$	ns
Receiver Enable to Output Low	$t_{RZL}$	Figures 3, $CL=100pF, S2$ closed		20	50	ns
Receiver Enable to Output High	$t_{RZH}$	Figures 3, $CL=100pF, S2$ closed		20	50	ns
Receiver Disable Time from Low	$t_{RLZ}$	Figures 3, $CL=100pF, S1$ closed		20	50	ns
Receiver Disable Time from High	$t_{RHZ}$	Figures 3, $CL=100pF, S2$ closed		20	50	ns
Time to Shutdown	$t_{SHDN}$	(Note 5)	50	200	600	ns
Driver Enable from Shutdown to Output High	$t_{DZH(SHDN)}$	Figures 5, $CL=15pF, S2$ closed			6000	ns
Driver Enable from Shutdown to Output Low	$t_{DZL(SHDN)}$	Figures 5, $CL=15pF, S1$ closed			6000	ns
Receiver Enable from Shutdown To Output high	$t_{RZH(SHDN)}$	Figures 3, $CL=100pF, S2$ closed			3500	ns
Receiver Enable from Shutdown To Output Low	$t_{RZL(SHDN)}$	Figures 3, $CL=100pF, S1$ closed			3500	ns

**SWITCHING CHARACTERISTICS-MAX3085 with SRL=Vcc**

 (Vcc=+5V ±5%, TA=T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at Vcc=+5V and TA=+25 )

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Driver Input to Output	t <sub>DPLH</sub>	Figures 4 and 6, R <sub>DIFF</sub> =54Ω, C <sub>L1</sub> =C <sub>L2</sub> =100pF	250	720	1000	ns
	t <sub>DPHL</sub>		250	720	1000	
Driver Output Skew  t <sub>DPLH</sub> - t <sub>DPHL</sub>	t <sub>DSKEW</sub>	Figures 4 and 6, R <sub>DIFF</sub> =54Ω, C <sub>L1</sub> =C <sub>L2</sub> =100pF		-3	±100	ns
Driver Rise or Fall Time	t <sub>DR</sub> , t <sub>DF</sub>	Figures 4 and 6, R <sub>DIFF</sub> =54Ω, C <sub>L1</sub> =C <sub>L2</sub> =100pF	200	530	750	ns
Maximum Data Rate	f <sub>MAX</sub>		500			kbps
Driver Enable to Output High	t <sub>DZH</sub>	Figures 5, CL=100pF, S2 closed			2500	ns
Driver Enable to Output Low	t <sub>DZL</sub>	Figures 5, CL=100pF, S1 closed			2500	ns
Driver Disable Time from Low	t <sub>DLZ</sub>	Figures 5, CL=15pF, S1 closed			100	ns
Driver Disable Time from High	t <sub>DHZ</sub>	Figures 5, CL=15pF, s2 closed			100	ns
Receiver Input to Output	t <sub>RPLH</sub> , t <sub>RPHL</sub>	Figures 7 and 8;  V <sub>ID</sub>  ≥2.0V; Rise and fall time of V <sub>ID</sub> ≤15ns		127	200	ns
t <sub>RPLH</sub> -t <sub>RPHL</sub>   Differential Receiver Skew	t <sub>RSKD</sub>	Figures 7 and 8;  V <sub>ID</sub>  ≥2.0V; Rise and fall time of V <sub>ID</sub> ≤15ns		3	±30	ns
Receiver Enable to Output Low	t <sub>RZL</sub>	Figures 3, CL=100pF, S1 closed		20	50	ns
Receiver Enable to Output High	t <sub>RZH</sub>	Figures 3, CL=100pF, S2 closed		20	50	ns
Receiver Disable Time from Low	t <sub>RLZ</sub>	Figures 3, CL=100pF, S1 closed		20	50	ns
Receiver Disable Time from High	t <sub>RHZ</sub>	Figures 3, CL=100pF, s2 closed		20	50	ns
Time to Shutdown	t <sub>SHDN</sub>	(Note 5)	50	200	600	ns
Driver Enable from Shutdown to Output High	t <sub>DZH(SHDN)</sub>	Figures 5, CL=15pF, S2 closed			4500	ns
Driver Enable from Shutdown to Output Low	t <sub>DZL(SHDN)</sub>	Figures 5, CL=15pF, S1 closed			4500	ns
Receiver Enable from Shutdown To Output High	t <sub>RZH(SHDN)</sub>	Figures 3, CL=100pF, S2 closed			3500	ns
Receiver Enable from Shutdown To Output Low	t <sub>RZL(SHDN)</sub>	Figures 3, CL=100pF, S1 closed			3500	ns

**SWITCHING CHARACTERISTICS max3088 with SRL=GND**

 (V<sub>CC</sub> = +5V ±5%, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>CC</sub> = +5V and T<sub>A</sub> = +25 °C.)

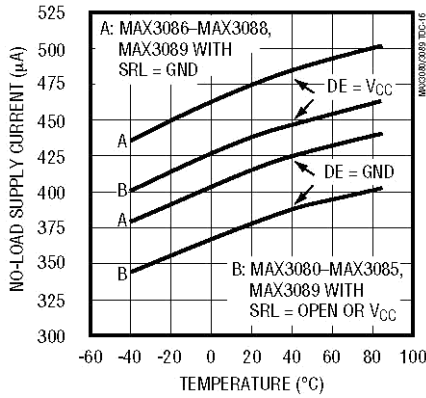
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Driver Input to Output	t <sub>DPLH</sub>	Figures 4 and 6, R <sub>DIFF</sub> =54Ω, C <sub>L1</sub> =C <sub>L2</sub> =100pF		34	60	ns
	t <sub>DPHL</sub>			34	60	
Driver Output Skew  t <sub>DPLH</sub> - t <sub>DPHL</sub>	t <sub>DSKEW</sub>	Figures 4 and 6, R <sub>DIFF</sub> =54Ω, C <sub>L1</sub> =C <sub>L2</sub> =100pF		-2.5	±10	ns
Driver Rise or Fall Time	t <sub>DR</sub> , t <sub>DF</sub>	Figures 4 and 6, R <sub>DIFF</sub> =54Ω, C <sub>L1</sub> =C <sub>L2</sub> =100pF		14	25	ns
Maximum Data Rate	f <sub>MAX</sub>		10			Mbps
Driver Enable to Output HIGH	t <sub>DZH</sub>	Figures 5, CL=100pF, S2 closed			150	ns
Driver Enable to Output Low	t <sub>DZL</sub>	Figures 5, CL=100pF, S1 closed			150	ns
Driver Disable Time from Low	t <sub>DLZ</sub>	Figures 5, CL=15pF, S1 closed			100	ns
Driver Disable Time from High	t <sub>DHZ</sub>	Figures 5, CL=15pF, s2 closed			100	ns
Receiver Input to Output	t <sub>RPLH</sub> , t <sub>RPHL</sub>	Figures 7 and 8;  V <sub>ID</sub>  ≥2.0V; Rise and fall time of V <sub>ID</sub> ≤15ns		106	150	ns
t <sub>RPLH</sub> - t <sub>RPHL</sub>   Differential Receiver Skew	t <sub>RSKD</sub>	Figures 7 and 8;  V <sub>ID</sub>  ≥2.0V; Rise and fall time of V <sub>ID</sub> ≤15ns		0	±10	ns
Receiver Enable to Output Low	t <sub>RZL</sub>	Figures 3, CL=100pF, S1 closed		20	50	ns
Receiver Enable to Output High	t <sub>RZH</sub>	Figures 3, CL=100pF, S2 closed		20	50	ns
Receiver Disable Time from Low	t <sub>RLZ</sub>	Figures 3, CL=100pF, S1 closed		20	50	ns
Receiver Disable Time from High	t <sub>RHZ</sub>	Figures 3, CL =100pF, S2 closed		20	50	ns
Time to Shutdown	t <sub>SHDN</sub>	(Note5)	50	200	600	ns
Driver Enable from Shutdown to Output High	t <sub>DZH(SHDN)</sub>	Figures 5, CL=15pF, S2 Closed			250	ns
Driver Enable from Shutdown to Output Low	t <sub>DZL(SHDN)</sub>	Figures 5, CL= 15pF, S1 closed			250	ns
Receiver Enable from Shutdown To Output High	t <sub>RZH(SHDN)</sub>	Figures 3, CL=100pF, S2 closed			3500	ns
Receiver Enable from Shutdown To Output Low	T <sub>RZL(SHDN)</sub>	Figures 3, CL=100pF, S1 closed			3500	ns

Note 5: The device is put into shutdown by bringing  $\overline{RE}$  high and DE low. If the enable inputs are in this state for less than 50ns, the device is guaranteed not to enter shutdown. If the enable inputs are in this state for at least 600ns, the device is guaranteed to have entered shutdown.

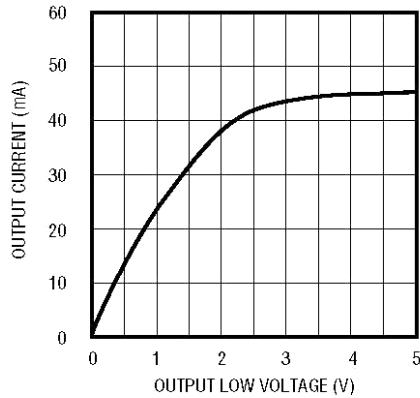
**Typical Operating Characteristics**

(V<sub>CC</sub> = +5V, T<sub>A</sub> = +25 °C, unless otherwise noted.)

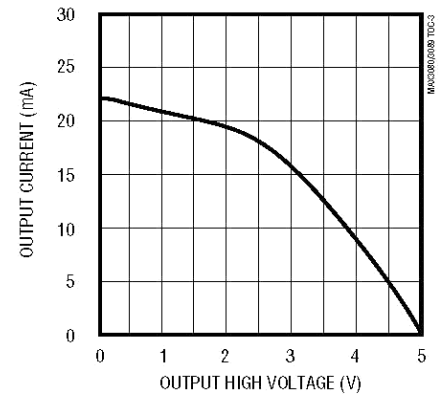
**NO-LOAD SUPPLY CURRENT VS. TEMPERATURE**



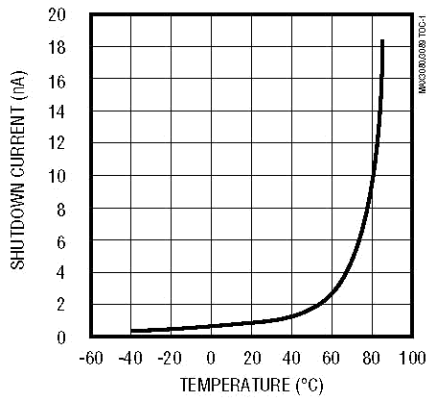
**OUTPUT CURRENT VS. RECEIVER OUTPUT LOW VOLTAGE**



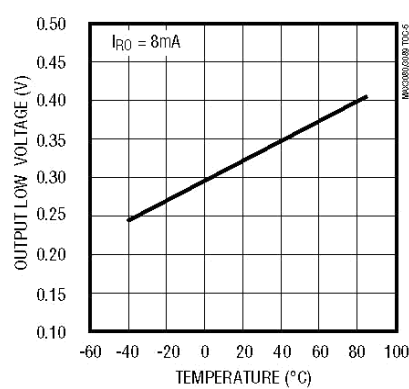
**OUTPUT CURRENT VS. RECEIVER OUTPUT HIGH VOLTAGE**



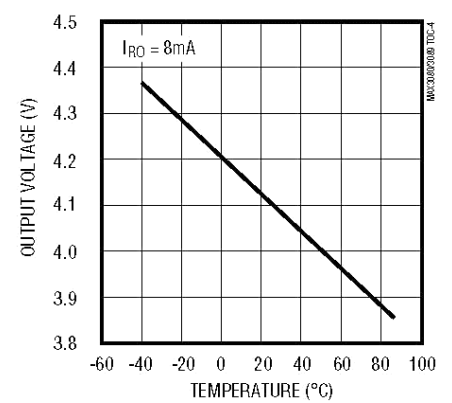
**SHUTDOWN CURRENT VS. TEMPERATURE**



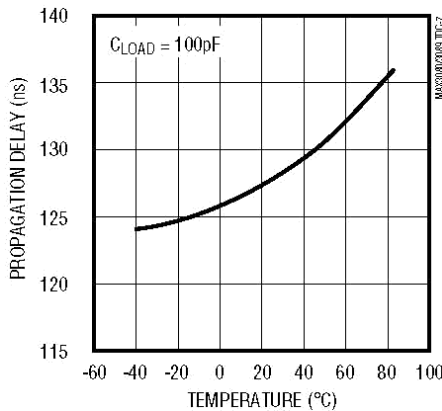
**RECEIVER OUTPUT LOW VOLTAGE VS. TEMPERATURE**



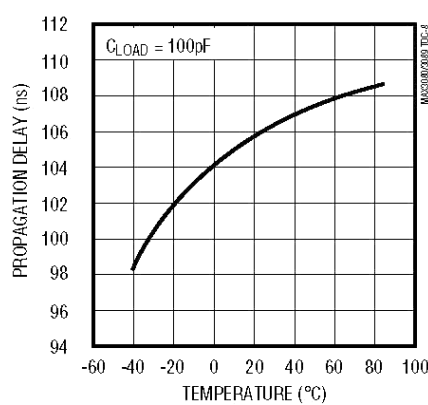
**RECEIVER OUTPUT HIGH VOLTAGE VS. TEMPERATURE**



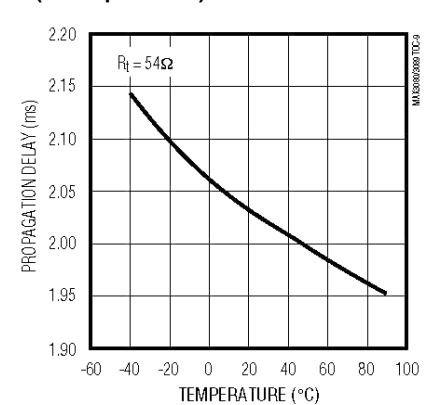
**RECEIVER PROPAGATION DELAY (500Kbps MODE) vs. TEMPERATURE**



**RECEIVER PROPAGATION DELAY (10Mbps MODE) vs. TEMPERATURE**



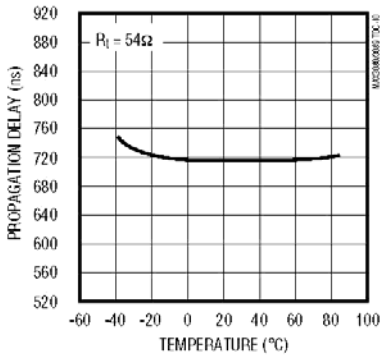
**DRIVER PROPAGATION DELAY (115Kbps MODE) vs. TEMPERATURE**



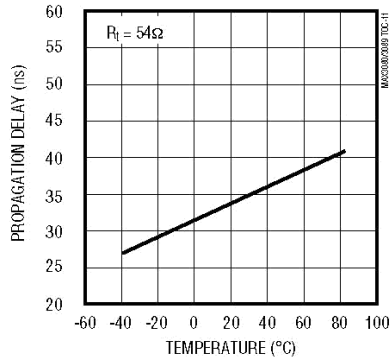
Typical Operating characteristics (continued)

(V<sub>CC</sub>=+5V, T<sub>A</sub>=+25 °C, unless otherwise noted.)

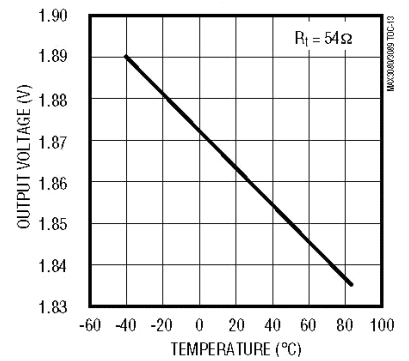
**DRIVER PROPAGATION DELAY (500Kbps MODE) vs. TEMPERATURE**



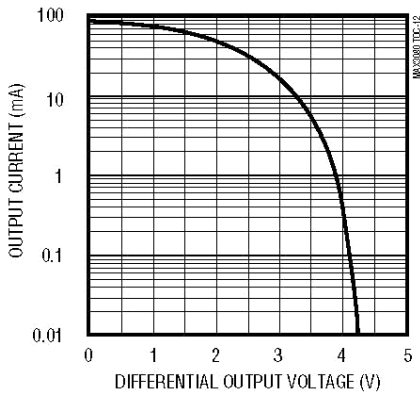
**DRIVER PROPAGATION DELAY (10Mbps MODE) vs. TEMPERATURE**



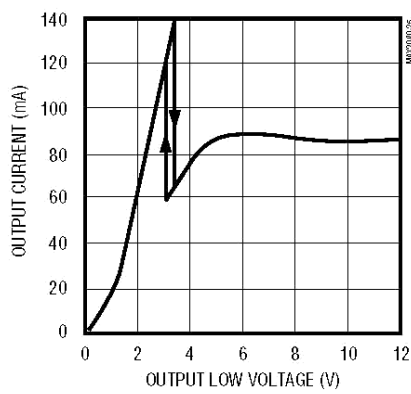
**DRIVER DIFFERENTIAL OUTPUT VOLTAGE vs. TEMPERATURE**



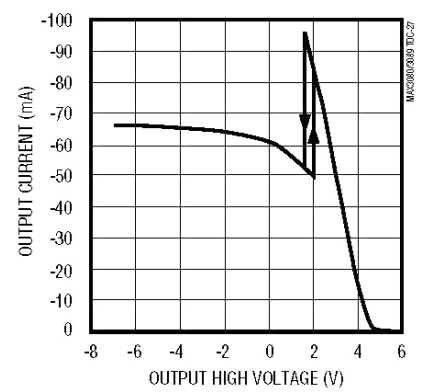
**DRIVER OUTPUT CURRENT vs. DIFFERENTIAL OUTPUT VOLTAGE**



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



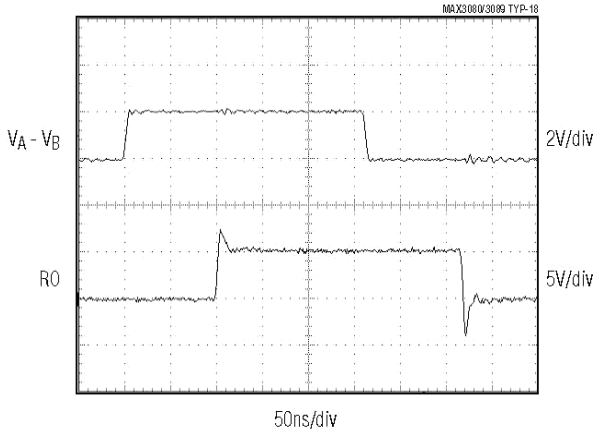
**DRIVER OUTPUT HIGH VOLTAGE vs. OUTPUT CURRENT**



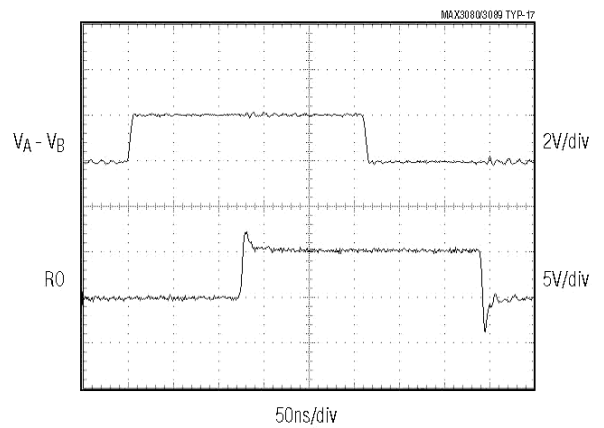
Typical Operating Characteristics (continued)

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

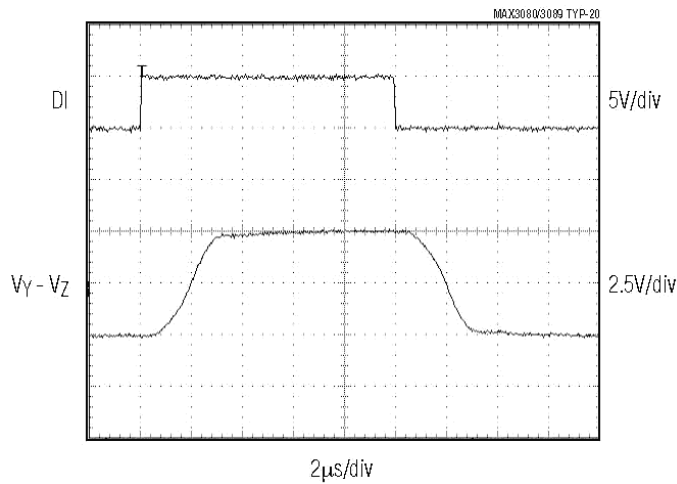
RECEIVER PROPAGATION DELAY  
MAX3088 WITH SRL=GND



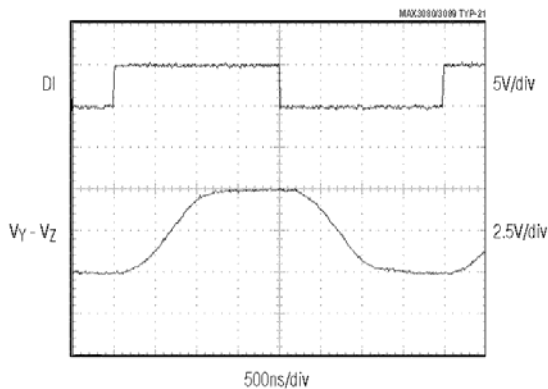
RECEIVER PROPAGATION DELAY  
MAX3082/MAX3085/MAX88 WITH SRL=GND



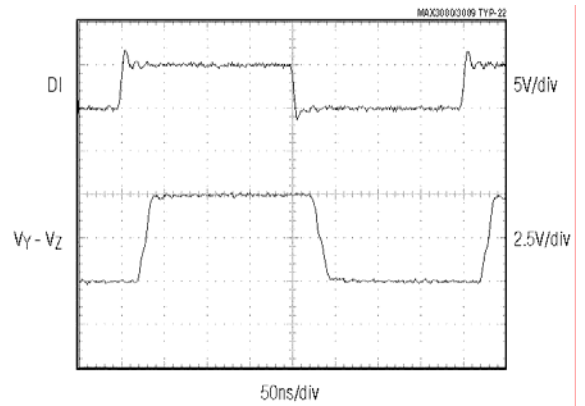
DRIVER PROPAGATION DELAY  
MAX3082 WITH SRL=OPEN



DRIVER PROPAGATION DELAY  
MAX3085 WITH SRL=Vcc



DRIVER PROPAGATION DELAY  
MAX3088 WITH SRL=GND



**Pin Description**

MAX3082 MAX3085 MAX3088 HALF-DUPLEX DEVICES	NAME	FUNCTION
—	H/ $\bar{F}$	Half/Full-Duplex Selector Pin. Connect H/ $\bar{F}$ to Vcc for half-duplex mode; connect to GND or leave unconnected for full-duplex mode.
1	RO	Receiver Output. When $\bar{R}\bar{E}$ is low and if A-B $\geq$ -50mV, RO will be high; if A-B $\leq$ -200mV, RO will be low.
2	$\bar{R}\bar{E}$	Receiver Output Enable. Drive $\bar{R}\bar{E}$ low to enable RO; RO is high impedance when $\bar{R}\bar{E}$ is high. Drive $\bar{R}\bar{E}$ high and DE low to enter Low-power shutdown mode.
3	DE	Driver Output Enable. Drive DE high to enable Driver outputs. These outputs are high impedance when DE is low. Drive $\bar{R}\bar{E}$ high and DE low to enter low-power shutdown mode.
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.
—	SRL	Slew-Rate-Limit Selector Pin. Connect SRL to GND for 10Mbps communication rate; connect to Vcc for 500kbps communication rate. Leave unconnected for 115kbps communication rate.
5	GND	Ground
—	TXP	Transmitter Phase. Connect TXP to GND, or leave floating for normal transmitter phase/polarity. Connect to Vcc to invert the transmitter phase/polarity.
—	Y	Noninverting Driver Output
—	Y	Noninverting Receiver Input and Noninverting Driver Output*
—	Z	Inverting Driver Output
—	Z	Inverting Receiver Input and Inverting Driver Output*
—	B	Inverting Receiver Input
—	B	Receiver Input Resistors*
7	B	Inverting Receiver Input and Inverting Driver Output
—	A	Noninverting Receiver input
—	A	Receiver Input Resistors*
6	A	Noninverting Receiver Input and Noninverting Driver Output
—	RXP	Receiver Phase. Connect RXP to GND, or leave unconnected for normal transmitter phase/polarity. Connect to Vcc invert the receiver phase/polarity.
8	Vcc	Positive Supply; 4.75V $\leq$ Vcc $\leq$ 5.25V
—	N.C.	Not Connected. Not internally connected.

\*(MAX3089 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 (continued)**

MAX3082/MAX3085/MAX3088

TRANSMITTING				
INPUTS			OUTPUTS	
$\bar{R}\bar{E}$	DE	DI	B/Z	A/Y
X	1	1	0	1
X	1	0	1	0
0	0	X	High-Z	High-Z
1	0	X	Shutdown	

RECEIVING			
INPUTS			OUTPUTS
$\bar{R}\bar{E}$	DE	A-B	RO
0	X	$\geq$ -0.05V	1
0	X	$\leq$ -0.2V	0
0	X	Open/shorted	1
1	1	X	High-Z
1	0	X	Shutdown

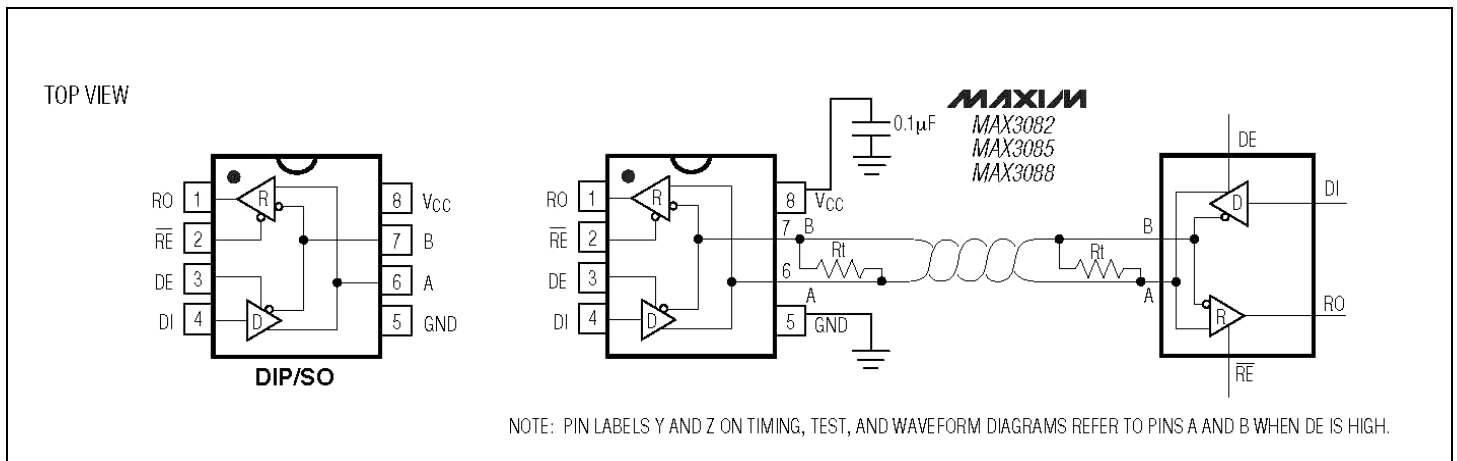


Figure 1. MAX3082/MAX3085/MAX3088 Pin Configuration and Typical Half-Duplex Operating Circuit

### Detailed Description

The MAX3082/MAX3085/MAX3088 high-speed transceivers for RS-485/RS422 communication contain one driver and one receiver. These devices feature fail-safe circuitry, which guarantees a logic-high receiver output when the connected to a terminated transmission line with all drivers disabled (see Fail-Safe section). The MAX3082 feature reduced slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free data transmission up to 115kbps (see Reduced EMI and Reflections section). The MAX3085 offer higher driver output slew rates are not limited making transmit speeds up to 10Mbps possible.

The MAX3082/MAX3085/MAX3088 are half-duplex transceivers.

All of these parts operate from a single +5V supply. Drivers are output short-circuit current limited. Thermal shutdown circuitry protects drivers against excessive power dissipation. When activated, the thermal shutdown circuitry places the driver outputs into a high-impedance state.

### Receiver Input Filtering

The receivers of the MAX3085 when operating in 115kbps or 500kbps mode, incorporate input filtering in addition to input hysteresis. This filtering enhances noise immunity with differential signals that have very slow rise and fall times. Receiver propagation delay increases by 20% due to this filtering.

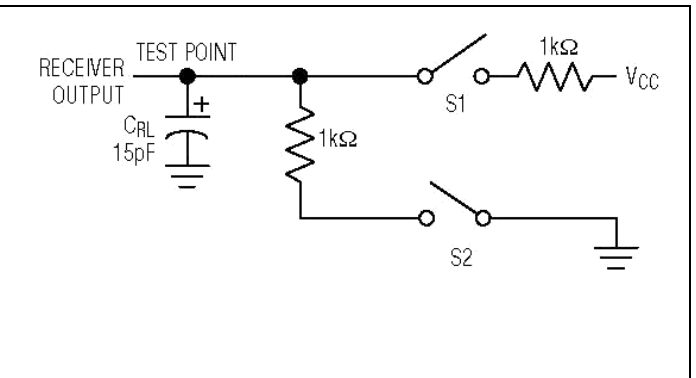
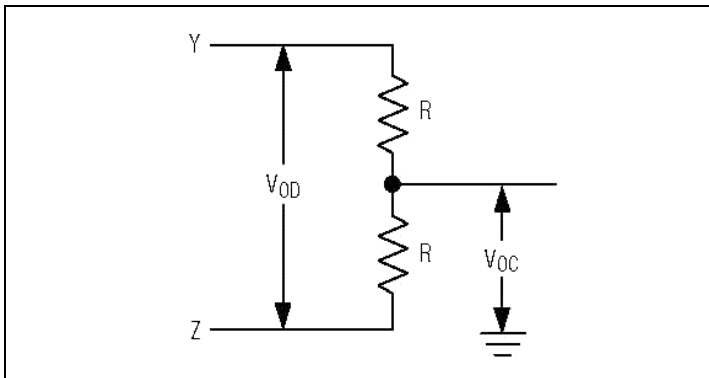


Figure 3. Receiver Enable/Disable Timing test Load

Figure 2. Driver DC test Load

## Applications Information

### Reduced EMI and Reflections

The MAX3082/MAX3085 with SRL=Vcc or unconnected, are slew-rate limited, minimizing EMI and reducing reflections caused by improperly terminated cables. Figure 9 shows the driver output waveform and its Fourier analysis of a 20 kHz signal transmitted by a MAX3088 with SRL=GND. High-frequency harmonic components with large amplitudes are evident Figure 10 shows the same signal displayed for MAX3085 with SRL=Vcc, transmitting under the same conditions. Figure 10's high-frequency harmonic components are much lower in amplitude, compared with Figure 9's, and the potential for EMI is significantly reduced. Figure 11 shows the

same signal displayed for a MAX3082 with SRL=unconnected, transmitting under the same conditions. Figure 11's high-frequency harmonic components are even lower.

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:

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

Where  $t_{\text{RISE}}$  is the transmitter's rise time.

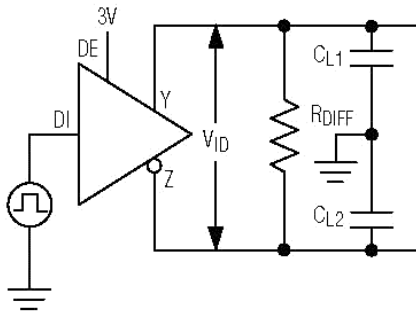


Figure 4. Driver Timing Test Circuit

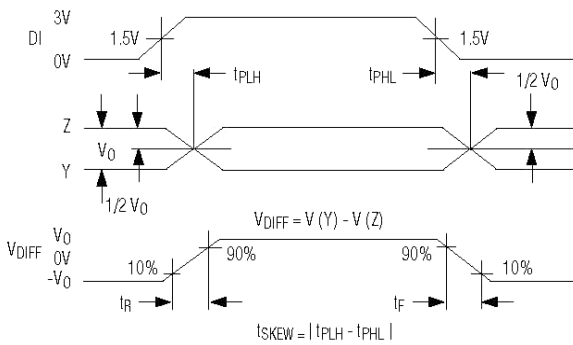


Figure 6. Driver Propagation Delays

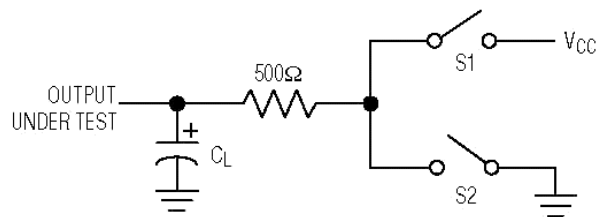


Figure 5. Driver Enable/Disable Timing Test Load

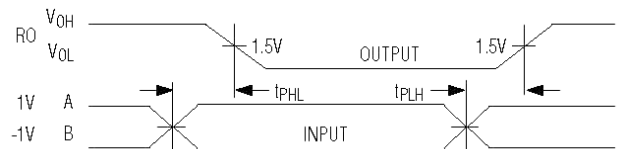


Figure 7. Receiver Propagation Delays

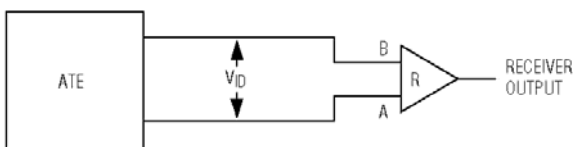


Figure 8. Receiver Propagation Delay Test Circuit

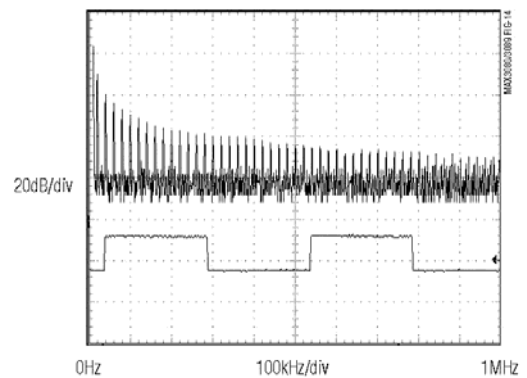


Figure 9. Driver Output Waveform and FFT Plot of MAX3088 with SRL=GND, Transmitting a 20kHz Signal

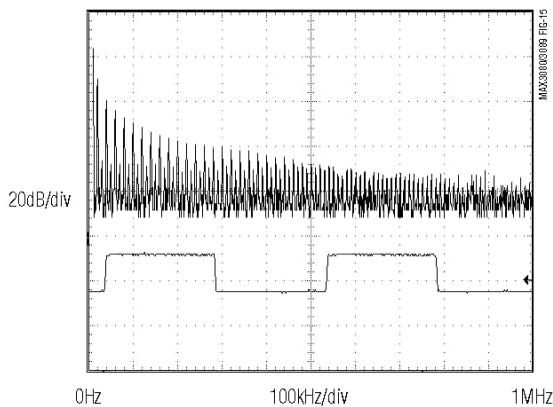


Figure 10. Driver Output Waveform and FFT Plot of MAX3085 with SRL=Vcc, Transmitting a 20kHz signal

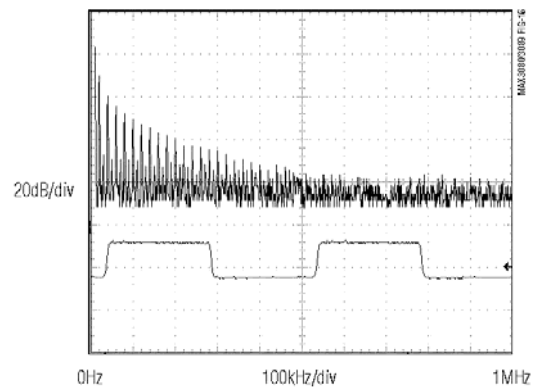
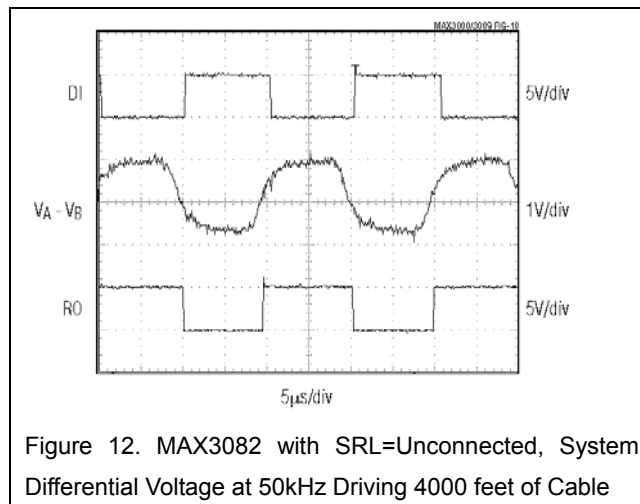


Figure 11. Driver Output Waveform and FFT Plot of MAX3082 with SRL=Unconnected, Transmitting a 20kHz signal



### Low-Power Shutdown Mode (Except MAX3082/MAX3085/MAX3088)

Low-power shutdown mode is initiated by bringing both  $\overline{RE}$  high and DE Low. In shutdown, the devices typically draw only 1nA 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 a low-power shutdown state. 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 low-power shutdown mode ( $t_{ZH(SHDN)}$ ,  $t_{ZL(SHDN)}$ ) than from driver/receiver-disable mode ( $t_{ZH}$ ,  $t_{ZL}$ ).

### Driver Output Protection

Two mechanisms prevent excessive output current and power dissipation caused by faults or by bus contention. The first, 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). The second, a thermal shutdown circuit, forces the driver outputs into a high-impedance state if the die temperature becomes excessive.

### Line Length vs. Data Rate

Figures 12, 13, and 14 show the system differential voltage for the parts driving 4000 feet of 26AWG twisted-pair wire at 110kHz into 120Ω loads.

### Typical Applications

The MAX3082/MAX3085/MAX3088 transceivers are designed for bi-directional data communications on multipoint bus transmission lines. Figures 15 show typical network applications circuits.

To minimize reflections, the line should be terminated at both ends in its characteristic impedance, and stub lengths off the main line should be kept as short as possible. The slew-rate-limited MAX3082/MAX3085 are more tolerant of imperfect termination.

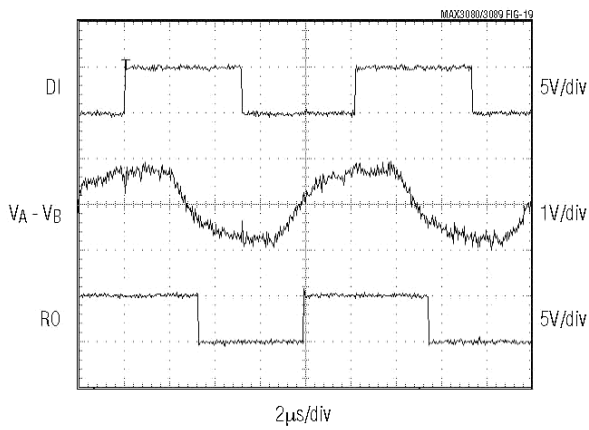


Figure 13. MAX3085 with SRL=Vcc, System Differential Voltage at 50kHz Driving 4000 feet of Cable

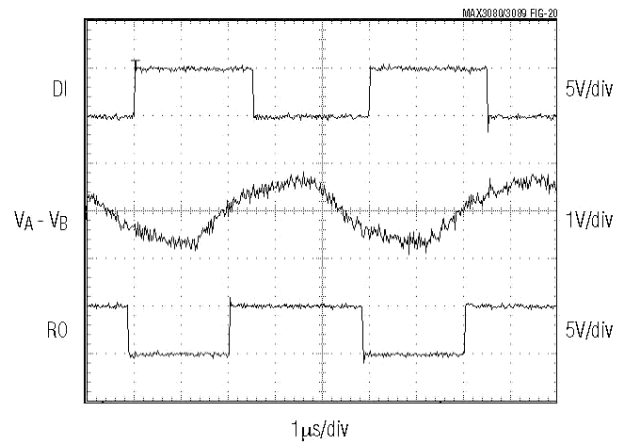


Figure 14. MAX3088 with SRL=GND, System Differential Voltage at 200kHz Driving 4000 feet of Cable

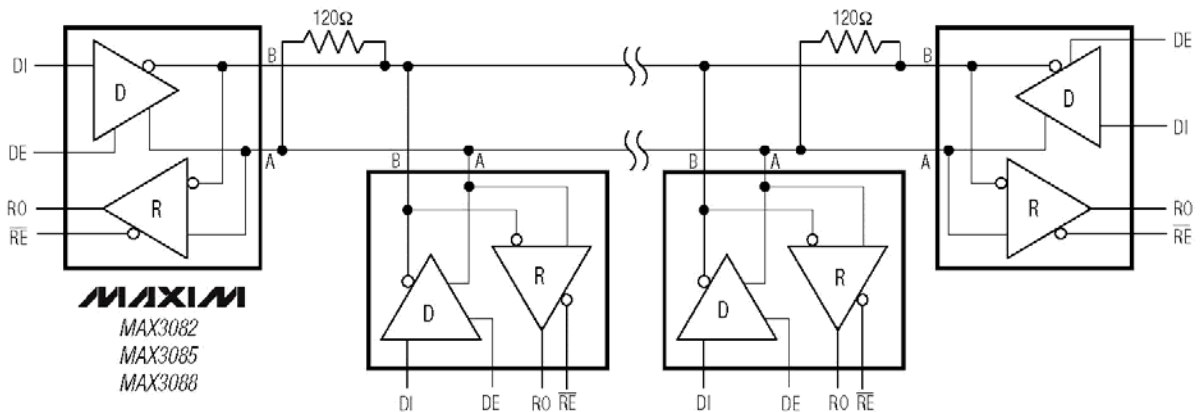


Figure 15. Typical Half-Duplex RS-485 Network

## Ordering Information (continued)

<b>PART</b>	<b>TEMP RANGE</b>	<b>PIN-PACKAGE</b>
MAX3082CSA	0 to +70	8 SO
MAX3082CPA	0 to +70	8 Plastic DIP
MAX3082ESA	-40 to +85	8 SO
MAX3082EPA	-40 to +85	8 Plastic DIP
MAX3085CSA	0 to +70	8 SO
MAX3085CPA	0 to +70	8 Plastic DIP
MAX3085ESA	-40 to +85	8 SO
MAX3085EPA	-40 to +85	8 Plastic DIP
MAX3088CSA	0 to +70	8 SO
MAX3088CPA	0 to +70	8 Plastic DIP
MAX3088ESA	-40 to +85	8 SO
MAX3088EPA	-40 to +85	8 Plastic DIP