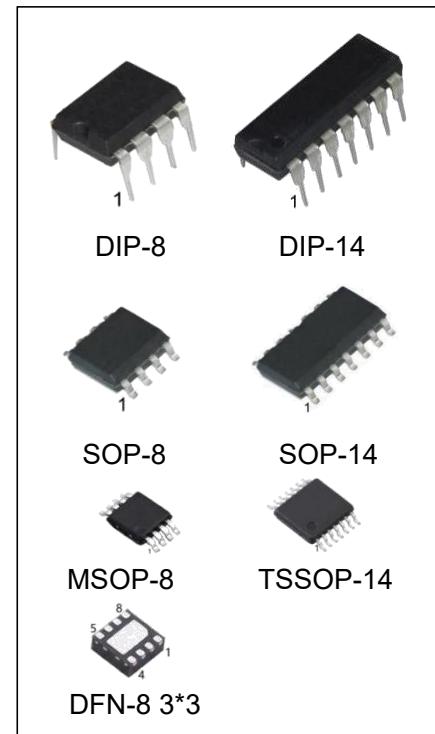


## Low-Power,RS-485/RS-422 Transceivers

### Feature

- Operate from a Single +3.3V Supply -No Charge Pump Required
- Interoperable with +5V Logic
- Guaranteed 12Mbps Data Rate (MAX3490E/MAX3491E)
- Slew-Rate Limited for Error less Data Transmission (MAX3488E)
- -7V to +12V Common-Mode Input Voltage Range
- Current-Limiting and Thermal Shutdown for Driver Overload Protection
- ESD Protection for RS-485 I/O Pins
  - ±15kV—Human Body Model
  - ±8kV—IEC 1000-4-2, Contact Discharge
  - ±15kV—IEC 1000-4-2, Air-Gap Discharge



### Ordering Information

DEVICE	PACKAGE TYPE	MARKING	PACKING	PACKING QTY
MAX3488EIN/HG	DIP-8	X3488EI	TUBE	2000pcs/box
MAX3488EIM/TR-HG	SOP-8	X3488EI	REEL	2500pcs/reel
MAX3488EIMM/TR-HG	MSOP-8	3488EI	REEL	3000pcs/reel
MAX3488EIDQ3/TR-HG	DFN-8 3*3	3488EI	REEL	5000pcs/reel
MAX3490EIN/HG	DIP-8	X3490EI	TUBE	2000pcs/box
MAX3490EIM/TR-HG	SOP-8	X3490EI	REEL	2500pcs/reel
MAX3490EIMM/TR-HG	MSOP-8	3490EI	REEL	3000pcs/reel
MAX3490EIDQ3/TR-HG	DFN-8 3*3	3490EI	REEL	5000pcs/reel
MAX3491EIN/HG	DIP-14	MAX3491EI	TUBE	1000pcs/box
MAX3491EIM/TR-HG	SOP-14	MAX3491EI	REEL	2500pcs/reel
MAX3491EIMT/TR-HG	TSSOP-14	X3491EI	REEL	2500pcs/reel

## General Description

Devices in the MAX3485E family (MAX3488E/ MAX3490E/ MAX3491E) are  $\pm 15\text{kV}$  ESD-protected, +3.3V, low-power transceivers for RS-422 communications. Each device contains one driver and one receiver.

The MAX3488E feature slew-rate-limited drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free data transmission at data rates up to 1Mbps. The MAX3490E, and MAX3491E transmit at up to 12Mbps.

All devices feature enhanced electrostatic discharge (ESD) protection. All transmitter outputs and receiver inputs are protected to  $\pm 15\text{kV}$  using IEC 1000-4-2 Air-Gap Discharge,  $\pm 8\text{kV}$  using IEC 1000-4-2 Contact Discharge, and  $\pm 15\text{kV}$  using the Human Body Model.

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 both inputs are open circuit. The MAX3488E, MAX3490E, and MAX3491E feature full duplex communication.

## Applications

- Telecommunications
- Industrial-Control Local Area Networks
- Transceivers for EMI-Sensitive Applications
- Integrated Services Digital Networks
- Packet Switching

## Block Diagram

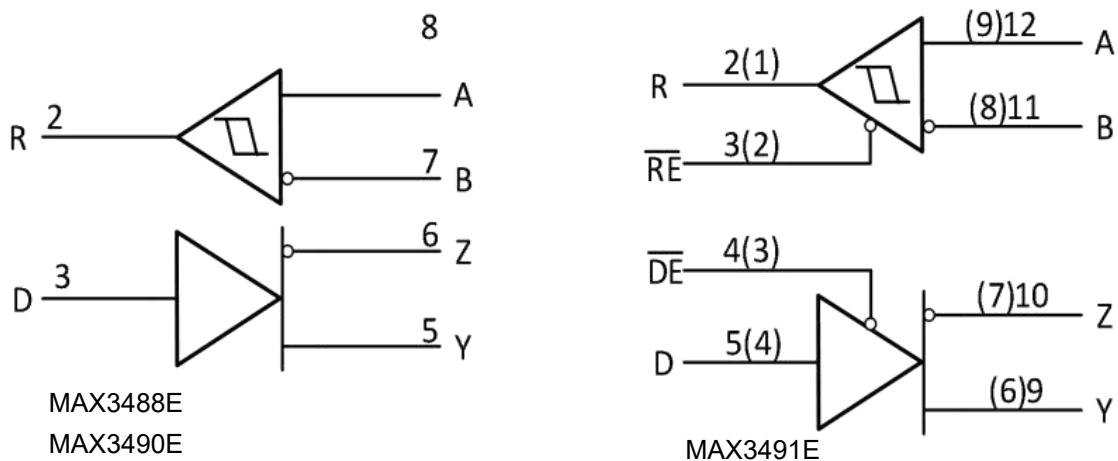
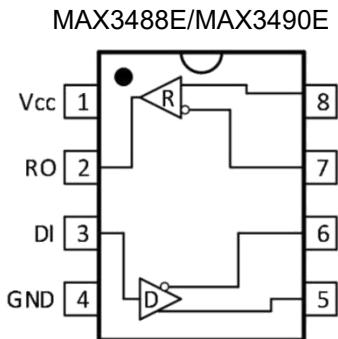
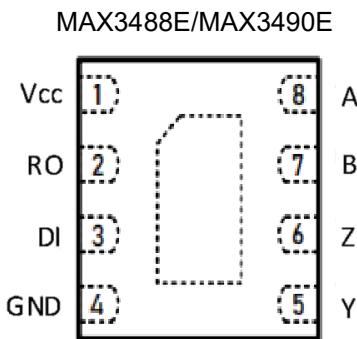


Figure 1 Simplified Schematic

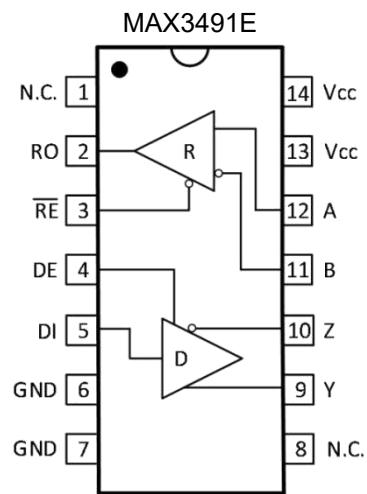
## Connection Diagrams



DIP-8/SOP-8/MSOP-8



DFN-8 3\*3



DIP-14/SOP-14/TSSOP-14

## Pin Description

PIN		NAME	FUNCTION
MAX3488E MAX3490E	MAX3491E		
2	2	RO	Receiver Output: If A > B by 200mV, RO will be high; If A < B by 200mV, RO will be low.
—	3	RE	Receiver Output Enable. RO is enabled when RE is low; RO is high impedance when RE is high.
—	4	RE	Driver Output Enable. The driver outputs, Y and Z, 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 RE is low.
3	5	DI	Driver Input. A low on DI forces output Y low and output Z high. Similarly, a high on DI forces output Y high and output Z low.
4	6, 7	GND	Ground
5	9	Y	Non-inverting Driver Output
6	10	Z	Inverting Driver Output
—	—	A	Non-inverting Receiver Input and Non-inverting Driver Output
8	12	A	Non-inverting Receiver Input
—	—	B	Inverting Receiver Input and Inverting Driver Output
7	11	B	Inverting Receiver Input
1	14	V <sub>CC</sub>	Positive Supply: 3.0V ≤ V <sub>CC</sub> ≤ 5.5V. Do not operate device with V <sub>CC</sub> > 5.5V
—	1, 8, 13	N.C.	No Connect—not internally connected

## Specifications

### ABSOLUTE GMIMUM RATINGS

Parameter	Description	MIN	MAX	UNIT
V <sub>CC</sub>	Supply Voltage		+7	V
RE , DE	Control Input Voltage	-0.3	+7	V
DI	Driver Input Voltage	-0.3	+7	V
A, B, Y, Z	Driver Output Voltage	-7.5	+12.5	V
A, B	Receiver Input Voltage	-7.5	+12.5	V
RO	Receiver Output Voltage	0.3	V <sub>CC</sub> +0.3	V
T <sub>A</sub>	Operating Temperature Range	-40	85	°C
T <sub>STG</sub>	Storage Temperature Range	-65	150	°C
T <sub>L</sub>	Lead Temperature (Soldering, 10 seconds)	-	260	°C

**Note:** Stress greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions outside those indicated in the operational sections of this specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## DC Electrical Characteristics

( $V_{CC} = +3.3V \pm 0.3V$ ,  $T_A = T_{MIN}$  to  $T_{GM}$ , unless otherwise noted. Typical values are at  $T_A = +25^{\circ}C$ .)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Differential Driver Output	$V_{OD}$	$R_L = 100\Omega$ (RS-422), Figure 4	2.0			V
		$R_L = 54\Omega$ (RS-485), Figure 4	1.5			
		$R_L = 60\Omega$ (RS-485), $V_{CC} = 3.3V$ , Figure 5	1.5			
Change in Magnitude of Driver Differential Output Voltage for Complementary Output States (Note 1)	$\Delta V_{OD}$	$R = 54\Omega$ or $100\Omega$ , Figure 4			0.2	V
Driver Common-Mode Output Voltage	$V_{OC}$	$R = 54\Omega$ or $100\Omega$ , Figure 4			3	V
Change in Magnitude of Driver Common-Mode Output Voltage for Complementary Output States	$\Delta V_{OC}$	$R = 54\Omega$ or $100\Omega$ , Figure 4			0.2	V
Input High Voltage	$V_{IH}$	DE, DI, $\overline{RE}$	2.0			V
Input Low Voltage	$V_{IL}$	DE, DI, $\overline{RE}$			0.8	V
Input Current	$I_{IN1}$	DE, DI, $\overline{RE}$ $V_{CC}$ floating			$\pm 2$	$\mu A$
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	
Output Leakage (Y, Z)	$I_O$	DE = 0V, $\overline{RE} = 0V$ , $V_{CC} = 0V$ or 3.6V, MAX3491E	$V_{OUT} = 12V$		100	$\mu A$
			$V_{OUT} = -7V$		-100	
Output Leakage (Y, Z) in Shutdown Mode	$I_O$	DE = 0V, $\overline{RE} = 3.6V$ , $V_{CC} = 0V$ or 3.6V, MAX3491E	$V_{OUT} = 12V$		100	$\mu A$
			$V_{OUT} = -7V$		-100	
Receiver Differential Threshold Voltage	$V_{TH}$	$-7V \leq V_{CM} \leq 12V$	-0.2		0.2	V
Receiver Input Hysteresis	$\Delta V_{TH}$	$V_{CM} = 0V$		50		$mV$
Receiver Output High Voltage	$V_{OH}$	$I_O = -4mA$ , $V_{ID} = 200mV$ , Figure 6	$V_{CC} - 0.4$			V

**DC Electrical Characteristics (continued)**

( $V_{CC} = +3.3V \pm 0.3V$ ,  $T_A = T_{MIN}$  to  $T_{GM}$ , unless otherwise noted. Typical values are at  $T_A = +25^{\circ}C$ .)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT	
Receiver Output Low Voltage	$V_{OL}$	$I_O = 4mA$ , $V_{ID} = -200mV$ , Figure 6				0.4	V	
Three-State (high impedance) Output Current at Receiver	$I_{OZR}$	$V_{CC} = 3.6V$ , $0V \leq V_{OUT} \leq V_{CC}$				$\pm 1$	$\mu A$	
Receiver Input Resistance	$R_{IN}$	$-7V \leq V_{CM} \leq 12V$		96			$k\Omega$	
Supply Voltage Range	$V_{CC}$			3.0		3.6	V	
Supply Current	$I_{CC}$	No load, $DI = 0$ or $V_{CC}$	$DE = V_{CC}$ , $\bar{RE} = 0$ or $V_{CC}$		0.5	1.0	mA	
			$DE = 0V$ , $\bar{RE} = 0$		0.45	0.9		
Supply Current in Shutdown Mode	$I_{SHDN}$	$DE = 0$ , $\bar{RE} = V_{CC}$ , $DI = V_{CC}$ or 0			1.3	2	$\mu A$	
Driver Short-Circuit Current	$I_{OSD}$	$V_{OUT} = -7V$				-250	mA	
		$V_{OUT} = 12V$				250		
Receiver Short-Circuit Output Current	$I_{OSR}$	$0V \leq V_O \leq V_{CC}$		$\pm 8$		$\pm 60$	mA	
ESD Protection for Y, Z, A, B		IEC 1000-4-2 Air Discharge		$\pm 15$			KV	
		IEC 1000-4-2 Contact Discharge (MAX3491E)		$\pm 8$				
		IEC 1000-4-2 Contact Discharge (MAX3490E, MAX3488E)		$\pm 8$				
		Human Body Model		$\pm 15$				

**Switching Characteristics(MAX3490E/MAX3491E)**
 $(V_{CC} = +3.3V, T_A = +25^{\circ}C.)$ 

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Maximum Data Rate			12	15		Mbps
Driver Differential Output Delay	$t_{DD}$	$R_L = 60\Omega$ , Figure 7	1	22	35	ns
Driver Differential Output Transition Time	$t_{DD}$	$R_L = 60\Omega$ , Figure 7	3	11	25	ns
Driver Propagation Delay, Low-to-High Level	$t_{PLH}$	$R_L = 27\Omega$ , Figure 8	7	23	35	ns
Driver Propagation Delay, High-to-Low Level	$t_{PHL}$	$R_L = 27\Omega$ , Figure 8	7	23	35	ns
$ t_{PLH} - t_{PHL} $ Driver Propagation Delay Skew (Note 2)	$t_{PDS}$	$R_L = 27\Omega$ , Figure 8		-1.4	$\pm 8$	ns

**DRIVER-OUTPUT ENABLE/DISABLE TIMES (MAX3491E only)**

Driver-Output Enable Time to Low Level	$t_{PZL}$	$R_L = 110\Omega$ , Figure 10		42	90	ns
Driver-Output Enable Time to High Level	$t_{PZH}$	$R_L = 110\Omega$ , Figure 9		42	90	ns
Driver-Output Disable Time from High Level	$t_{PHZ}$	$R_L = 110\Omega$ , Figure 9		35	80	ns
Driver-Output Disable Time from Low Level	$t_{PLZ}$	$R_L = 110\Omega$ , Figure 10		35	80	ns
Driver-Output Enable Time from Shutdown to Low Level	$t_{PSL}$	$R_L = 110\Omega$ , Figure 10		650	900	ns
Driver-Output Enable Time from Shutdown to High Level	$t_{PSH}$	$R_L = 110\Omega$ , Figure 9		650	900	ns

**SWITCHING CHARACTERISTICS(MAX3488E)**
 $(V_{CC} = +3.3V, T_A = +25^{\circ}C.)$ 

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Maximum Data Rate				1000		Kbps
Driver Differential Output Delay	$t_{DD}$	$R_L = 60\Omega$ , Figure 7	200	300	500	ns
Driver Differential Output Transition Time	$t_{DD}$	$R_L = 60\Omega$ , Figure 7	150	240	400	ns
Driver Propagation Delay, Low-to-High Level	$t_{PLH}$	$R_L = 27\Omega$ , Figure 8	200	300	500	ns
Driver Propagation Delay, High-to-Low Level	$t_{PHL}$	$R_L = 27\Omega$ , Figure 8	200	300	500	ns
$ t_{PLH} - t_{PHL} $ Driver Propagation Delay Skew (Note 2)	$t_{PDS}$	$R_L = 27\Omega$ , Figure 8		$\pm 50$		ns
Driver-Output Enable Time to Low Level	$t_{PZL}$	$R_L = 110\Omega$ , Figure 10		300	500	ns
Driver-Output Enable Time to High Level	$t_{PZH}$	$R_L = 110\Omega$ , Figure 9		150	400	ns
Driver-Output Disable Time from High Level	$t_{PHZ}$	$R_L = 110\Omega$ , Figure 9		50	80	ns
Driver-Output Disable Time from Low Level	$t_{PLZ}$	$R_L = 110\Omega$ , Figure 10		50	80	ns
Driver-Output Enable Time from Shutdown to Low Level	$t_{PSL}$	$R_L = 110\Omega$ , Figure 10		1.9	2.7	$\mu s$
Driver-Output Enable Time from Shutdown to High Level	$t_{PSH}$	$R_L = 110\Omega$ , Figure 9		2.2	3.0	$\mu s$

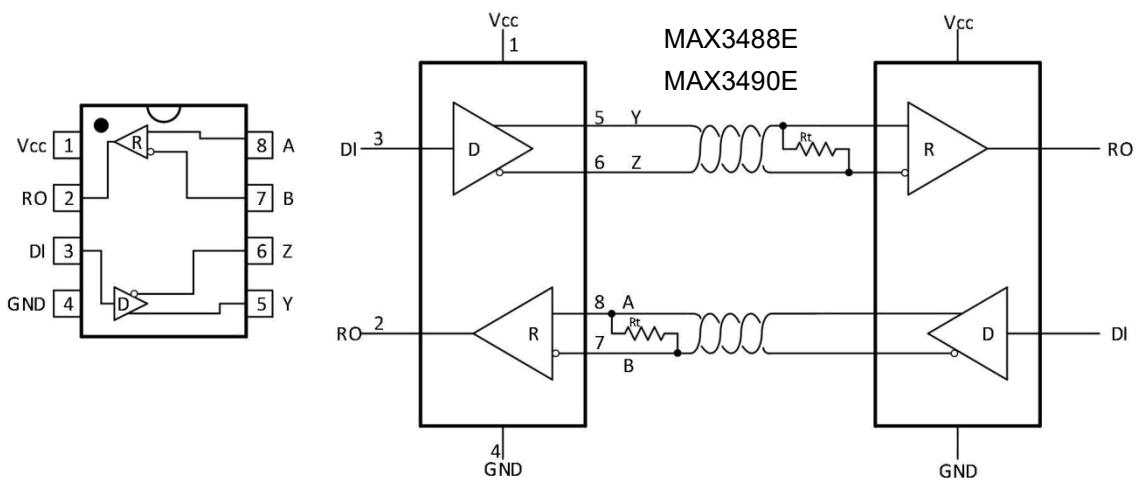
**Notes For Electrical/Switching Characteristics**

Note 1:  $\Delta V_{OD}$  and  $\Delta V_{OC}$  are the changes in  $V_{OD}$  and  $V_{OC}$ , respectively, when the DI input changes state.

Note 2: Measured on  $|t_{PLH}(Y) - t_{PHL}(Y)|$  and  $|t_{PLH}(Z) - t_{PHL}(Z)|$ .

Note 3: The transceivers are put into shutdown by bringing high RE and DE low. If the inputs are in this state for less than 80ns, the parts are guaranteed not to enter shutdown. If the inputs are in this state for at least 300ns, the parts are guaranteed to have entered shutdown. See Low-Power Shutdown Mode section.

TOP VIEW



NOTE: TYPICAL OPERATING CIRCUIT SHOWN WITH DIP/SO PACKAGE

Figure 2. MAX3488E/MAX3490E Pin Configuration and Typical Operating Circuit

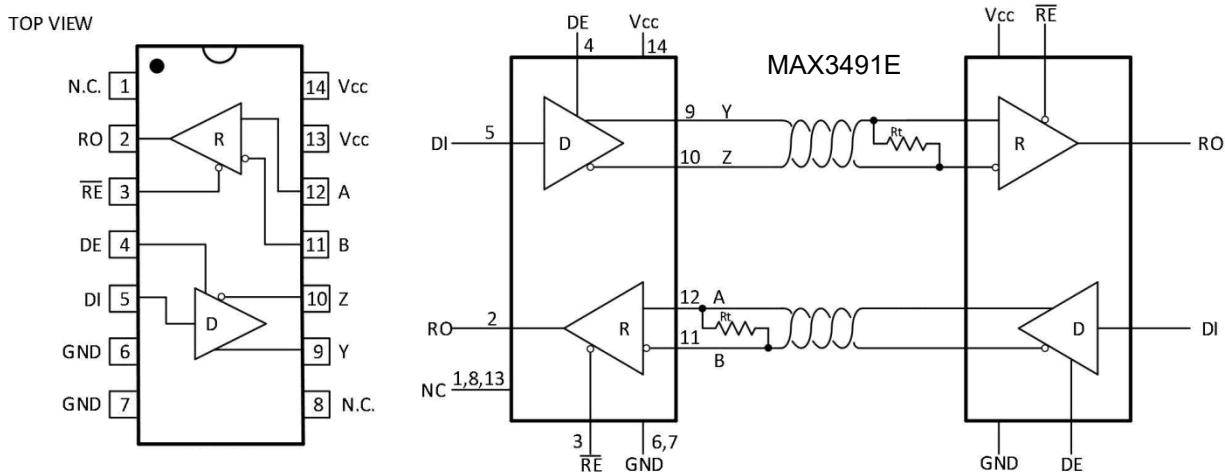


Figure 3. MAX3491E Pin Configuration and Typical Operating Circuit

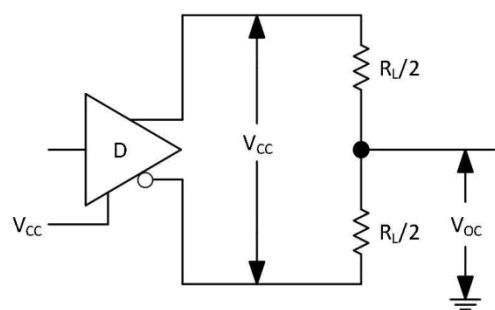


Figure 4. Driver  $V_{OD}$  and  $V_{OC}$

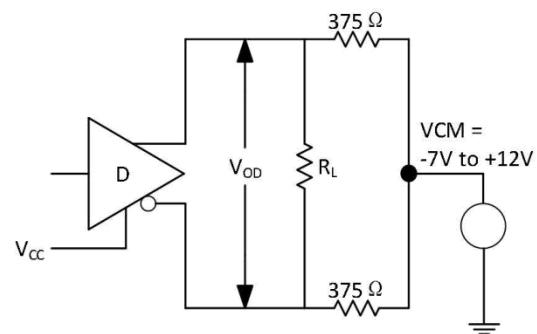


Figure 5. Driver  $V_{OD}$  with Varying Common-Mode Voltage

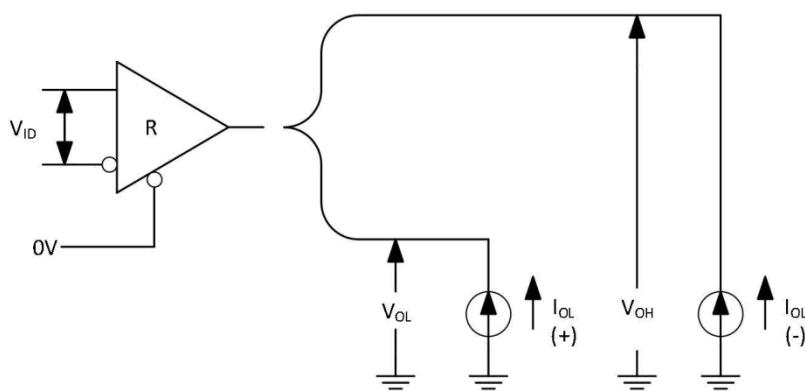


Figure 6. Receiver  $V_{OH}$  and  $V_{OL}$

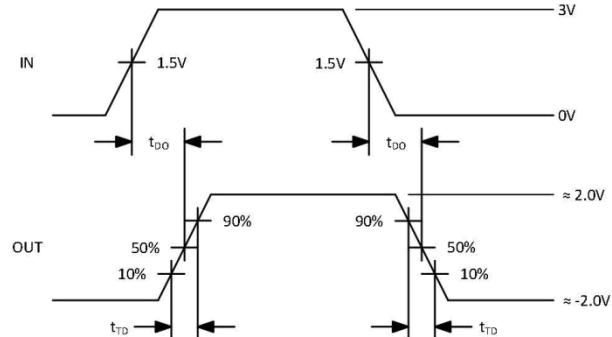
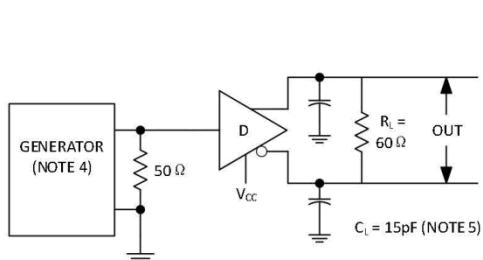


Figure 7. Driver Differential Output Delay and Transition Times

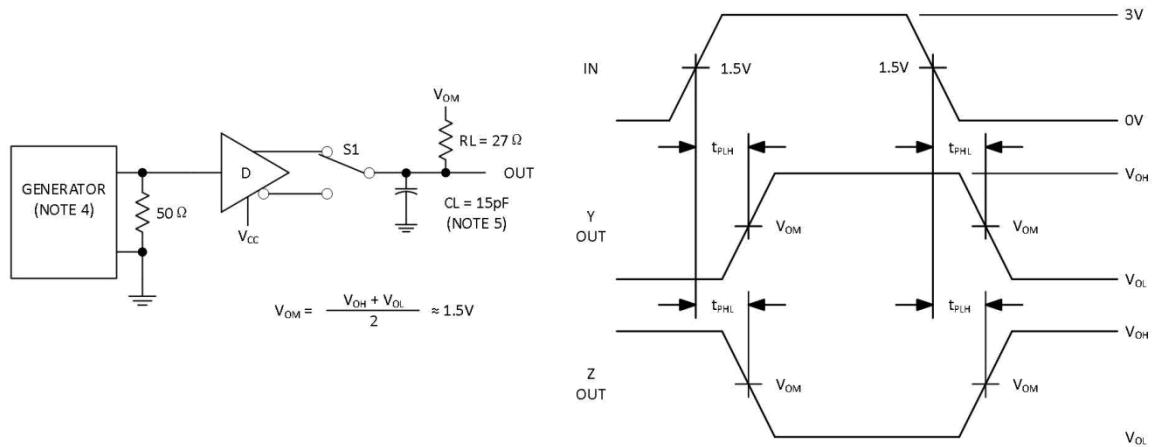


Figure 8. Driver Propagation Times

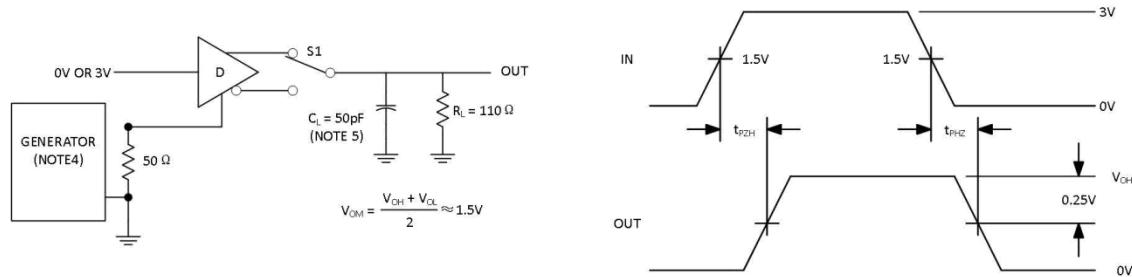


Figure 9. Driver Enable and Disable Times ( $t_{PZH}$ ,  $t_{PSH}$ ,  $t_{PHZ}$ )

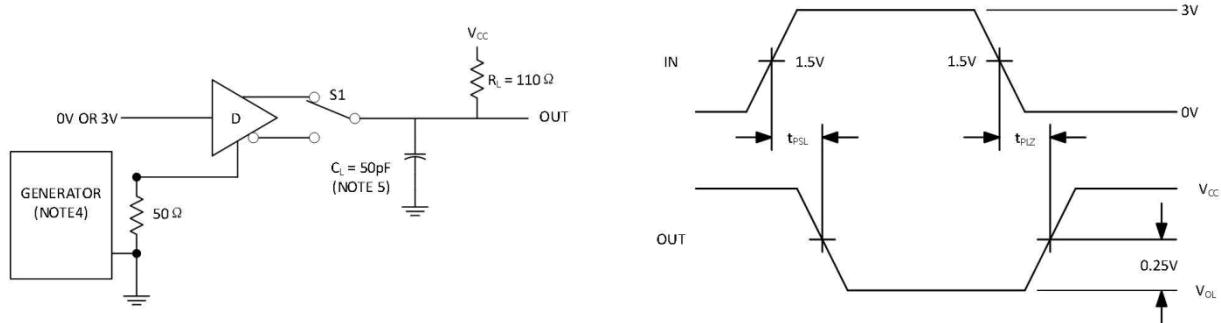


Figure 10. Driver Enable and Disable Times ( $t_{PZL}$ ,  $t_{PSL}$ ,  $t_{PLZ}$ )

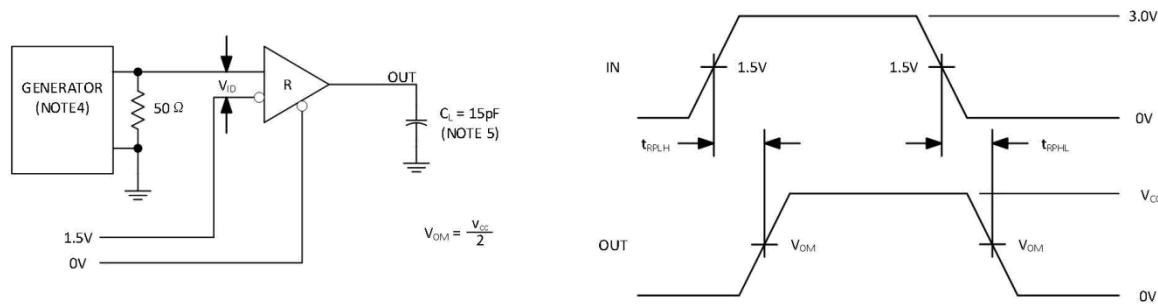


Figure 11. Receiver Propagation Delay

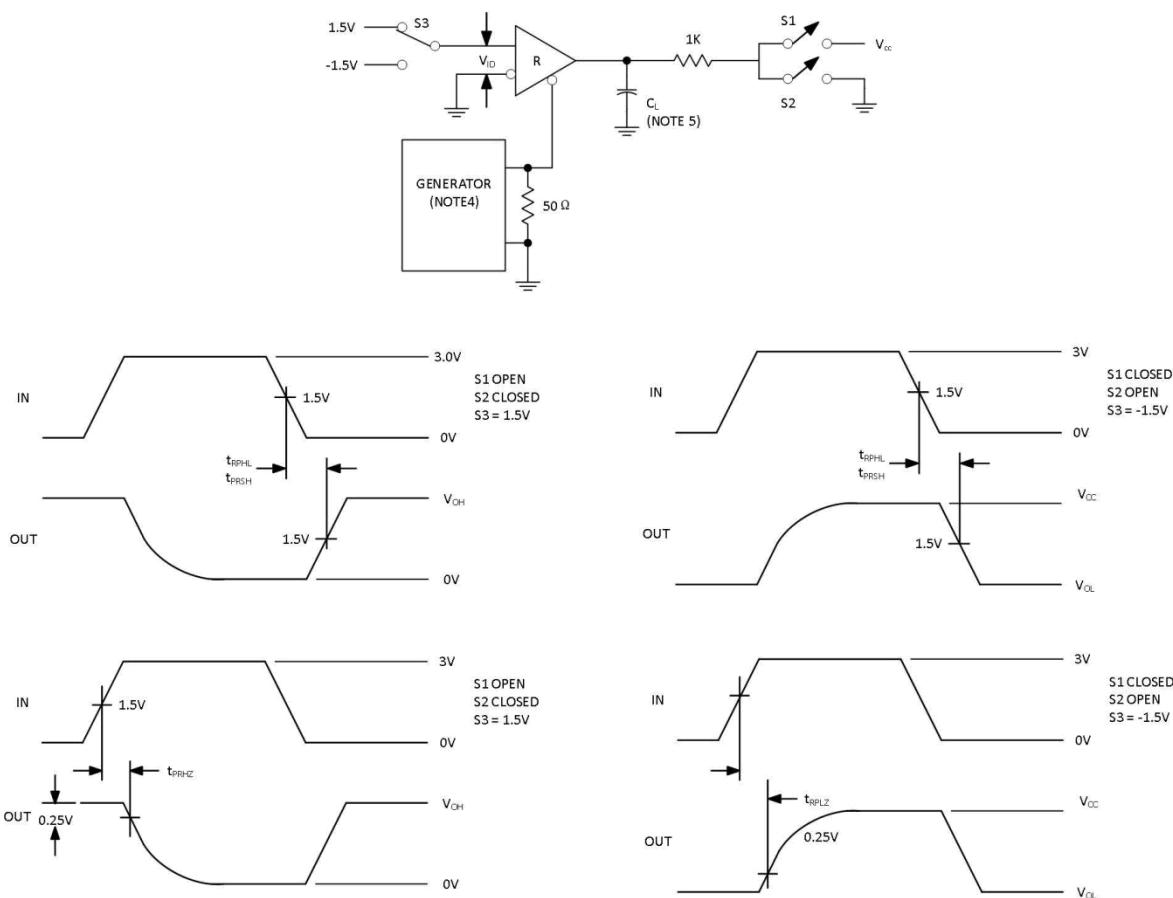


Figure 12. Receiver Enable and Disable Times

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

Note 5:  $C_L$  includes probe and stray capacitance.

## Function Tables

### Devices with Receiver/Driver Enable (MAX3491E)

Table 1. Transmitting

INPUTS			OUTPUTS		MODE
$\overline{RE}$	DE	DI	B*	A*	
x	1	1	0	1	Normal
x	1	0	1	0	Normal
0	0	x	High-Z	High-Z	Normal
1	0	x	High-Z	High-Z	Shutdown

\* B and A outputs are Z and Y, respectively, for full-duplex part (MAX3491E).

X = Don't care; High-Z = High impedance

Table 2. Receiving

INPUTS			OUTPUTS		MODE
$\overline{RE}$	DE	A,B	RO		
x	1	$\geq +0.2V$	1		Normal
x	1	$\leq -0.2V$	0		Normal
0	0	Inputs Open	1		Normal
1	0	x	High-Z		Shutdown

\* DE is a "don't care" (x) for the full-duplex part (MAX3491E).

X = Don't care; High-Z = High impedance

### Devices without Receiver/Driver Enable(MAX3488E/MAX3490E)

Table 3. Transmitting

INPUT	OUTPUTS	
DI	Z	Y
1	0	1
0	1	0

Table 4. Receiving

INPUT	OUTPUT
A,B	RO
$\geq +0.2V$	1
$\leq -0.2V$	0
Inputs Open	1

## Applications Information

The MAX3488E/MAX3490E/MAX3491E are low-power transceivers for RS-485 and RS-422 communications. The MAX3488E can transmit and receive at data rates up to 1Mbps, and the MAX3490E/MAX3491E at up to 12Mbps. The MAX3488E/MAX3490E/MAX3491E are full-duplex transceivers, Driver Enable (DE) and Receiver Enable (RE) pins are included on the MAX3491E. When disabled, the driver and receiver outputs are high impedance.

### Reduced EMI and Reflections(MAX3488E)

The MAX3488E are slew-rate limited, minimizing EMI and reducing reflections caused by improperly terminated cables. Figure 13 shows the driver output waveform of a MAX3490E/MAX3491E transmitting a 125kHz signal, as well as the Fourier analysis of that waveform. High-frequency harmonics with large amplitudes are evident. Figure 14 shows the same information, but for the slew-rate-limited MAX3488E transmitting the same signal. The high-frequency harmonics have much lower amplitudes, and the potential for EMI is significantly reduced.

### Low-Power Shutdown Mode(MAX3491E)

A low-power shutdown mode is initiated by bringing both RE high and DE low. The devices will not shut down unless both the driver and receiver are disabled (high impedance). In shutdown, the devices typically draw only 1.3uA of supply current. For these devices, the  $t_{PSH}$  and  $t_{PSL}$  enable times assume the part was in the low-power shutdown mode; the  $t_{PZH}$  and  $t_{PZL}$  enable times assume the receiver or driver was disabled, but the part was not shut down.

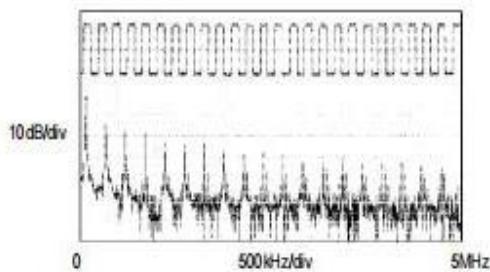


Figure 13. Driver Output Waveform and FFT Plot of MAX3490E/MAX3491E Transmitting a 125kHz Signal

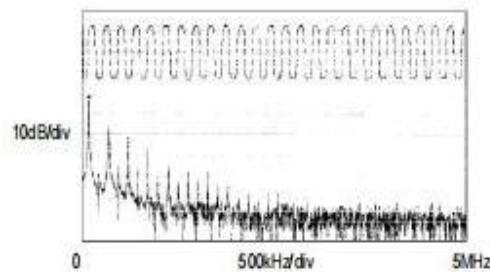


Figure 14. Driver Output Waveform and FFT Plot of MAX3488E Transmitting a 125kHz Signal

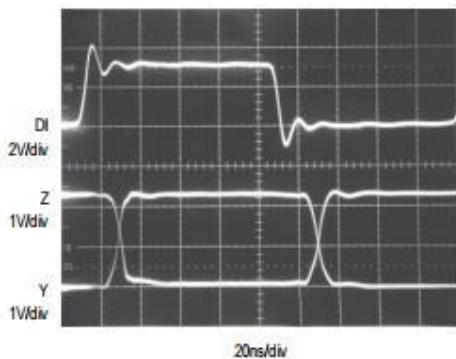
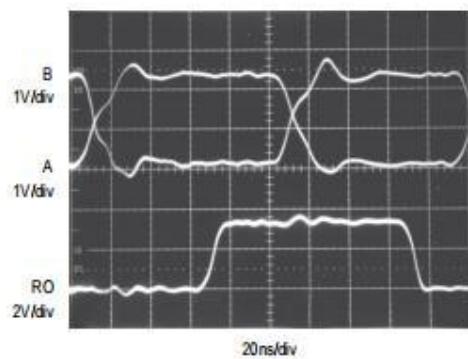
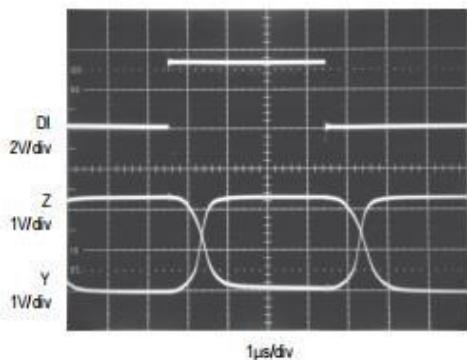


Figure 15. MAX3490E/MAX3491E Driver



Propagation Delay

Figure 16. MAX3490E/MAX3491E Receiver Propagation



Delay Driven by External RS-485 Device

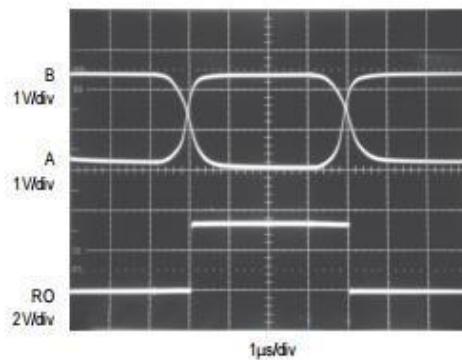


Figure 17. MAX3488E Driver Propagation Delay

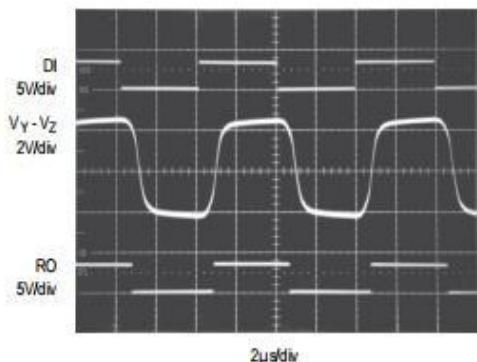


Figure 18. MAX3488E Receiver Propagation Delay

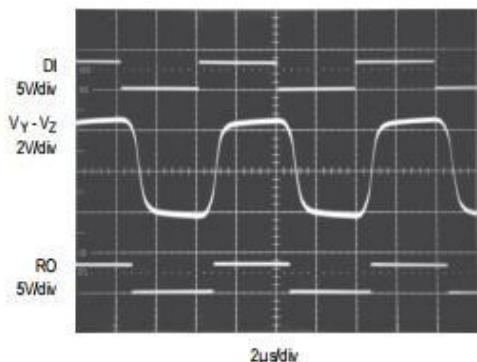


Figure 19. MAX3488E System Differential Voltage at 125kHz Driving 4000 Feet of Cable

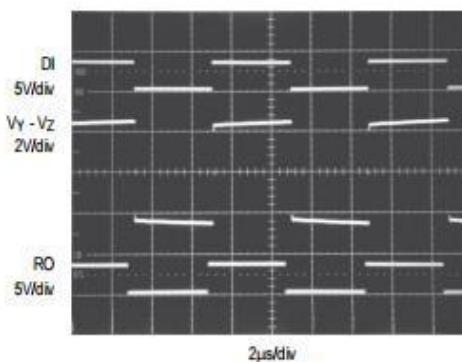


Figure 20. MAX3490E/MAX3491E System Differential Voltage at 125kHz Driving 4000 Feet of Cable

## Driver Output Protection

Excessive output current and power dissipation caused by faults or by bus contention are prevented by two mechanisms. A fold-back current limit on the output stage provides immediate protection against short circuits over the whole common-mode voltage range. In addition, a thermal shutdown circuit forces the driver outputs into a high-impedance state if the die temperature rises excessively.

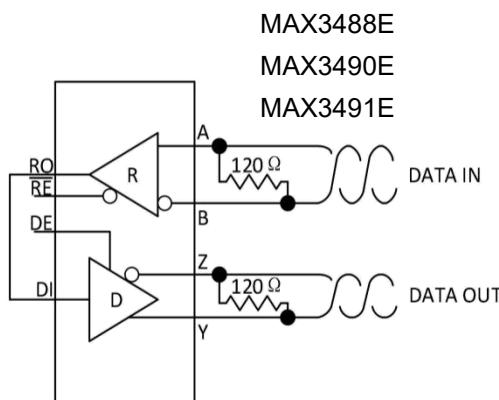
## Propagation Delay

Figures 15–18 show the typical propagation delays. Skew time is simply the difference between the low-to-high and high-to-low propagation delay. Small driver/receiver skew times help maintain a symmetrical mark-space ratio (50% duty cycle). The receiver skew time,  $|t_{PRLH} - t_{PRHL}|$ , is under 10ns 20ns for the MAX3488E). The driver skew times are 8ns for the MAX3490E/MAX3491E.

## 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, see Figure 21 for an example of a line repeater. Figures 19 and 20 show the system differential voltage for parts driving 4000 feet of 26AWG twisted-pair wire at 125kHz into 120Ω loads. For faster data rate transmission,

please consult the factory



Note : RE and DE on MAX3488E/MAX3490E/MAX3491E

Figure 21. Line Repeater for MAX3488E/MAX3490E/MAX3491E

## ±15kV ESD Protection

ESD-protection structures are incorporated on all pins to protect against electrostatic discharges encountered during handling and assembly. The driver outputs and receiver inputs of the GM3485E family of devices have extra protection against static electricity. Engineers have developed state-of the-art structures to protect these pins against ESD of ±15kV without damage. The ESD structures withstand high ESD in all states: normal operation, shutdown, and powered down.

ESD protection can be tested in various ways; the transmitter outputs and receiver inputs of this product family are characterized for protection to the following limits:

- 1) ±15kV using the Human Body Model
- 2) ±8kV using the Contact-Discharge method specified in IEC 1000-4-2
- 3) ±15kV using IEC 1000-4-2's Air-Gap method.

## ESD Test Conditions

ESD performance depends on a variety of conditions. Contact us for a reliability report that documents test setup, test methodology, and test results.

### Human Body Model

Figure 22a shows the Human Body Model and Figure 22b shows the current waveform it generates when discharged into a low impedance. This model consists of a 100pF capacitor charged to the ESD voltage of interest, which is then discharged into the test device through a 1.5kΩ resistor.

## IEC 1000-4-2

The IEC 1000-4-2 standard covers ESD testing and performance of finished equipment; it does not specifically refer to integrated circuits. The GM3485E family of devices helps you design equipment that meets Level 4 (the highest level) of IEC 1000-4-2, without the need for additional ESD-protection components.

The major difference between tests done using the Human Body Model and IEC 1000-4-2 is higher peak current in IEC 1000-4-2, because series resistance is lower in the IEC 1000-4-2 model. Hence, the ESD withstand voltage measured to IEC 1000-4-2 is generally lower than that measured using the Human Body Model. Figure 23a shows the IEC 1000-4-2 model, and Figure 23b shows the current waveform for the  $\pm 8\text{kV}$  IEC 1000-4-2, Level 4 ESD contact-discharge test.

The air-gap test involves approaching the device with a charged probe. The contact-discharge method connects the probe to the device before the probe is energized.

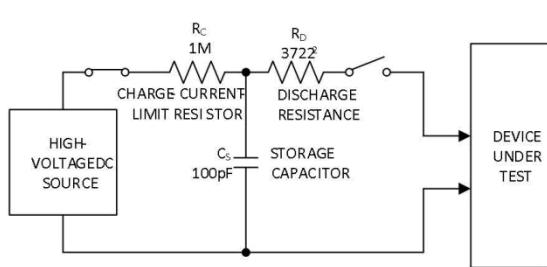


Figure 22a. Human Body ESD Test Model

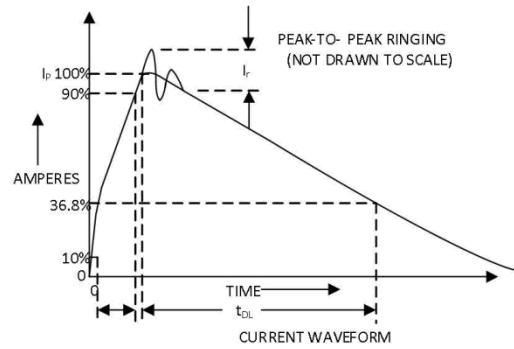


Figure 22b. Human Body Current Waveform

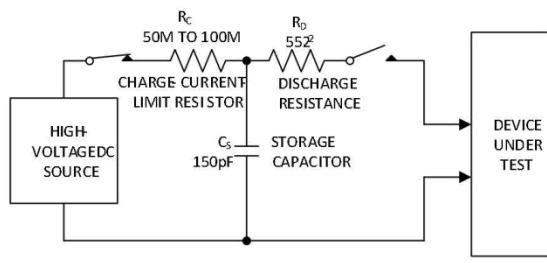


Figure 23a. IEC 1000-4-2 ESD Test Model

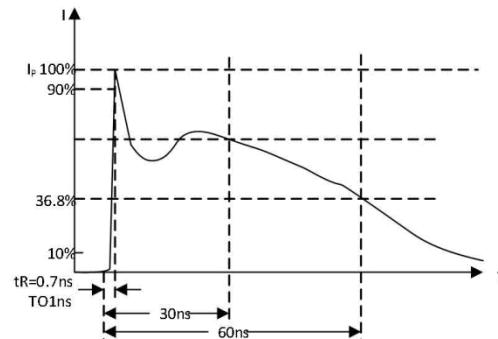


Figure 23b. IEC 1000-4-2 ESD Generator Current Waveform

## Machine Model

The Machine Model for ESD tests all pins using a 200pF storage capacitor and zero discharge resistance. Its objective is to emulate the stress caused when I/O pins are contacted by handling equipment during test and assembly. of course, all pins require this protection, not just RS-485 inputs and outputs.

## Typical Applications

The MAX3488E/MAX3490E/MAX3491E transceivers are designed for bidirectional data communications on multi point bus transmission lines. Figures 24 show typical network applications circuits. These parts can also be used as line repeaters, with cable lengths longer than 4000 feet, as shown in Figure 21.

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 MAX3488E is more tolerant of imperfect termination.

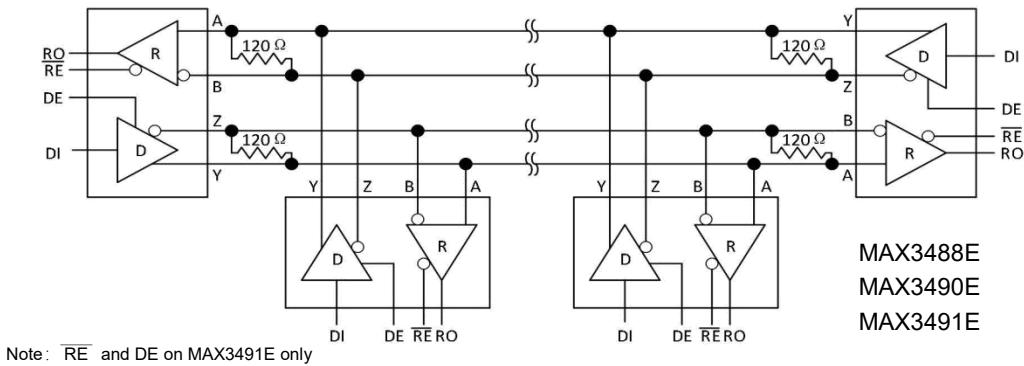
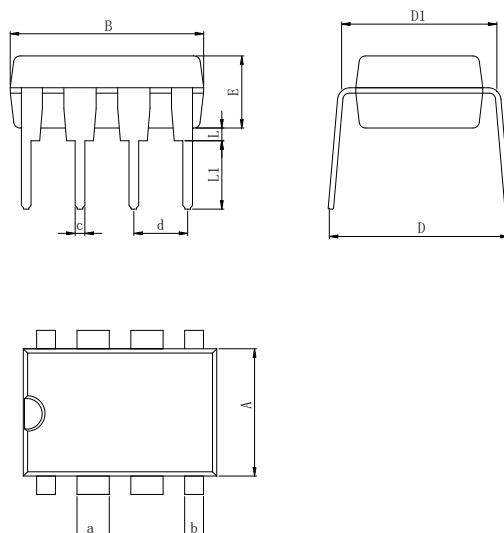


Figure 24. MAX3488E/MAX3490E/MAX3491E Full-Duplex RS-485 Network

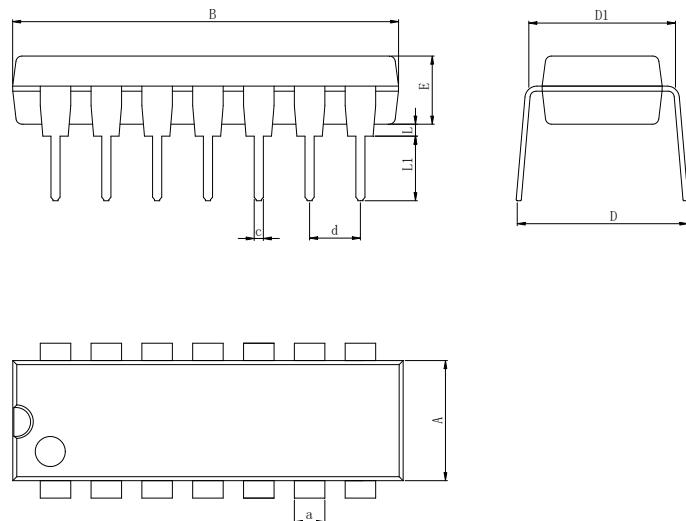
## Physical Dimensions

### DIP-8



Dimensions In Millimeters(DIP-8)											
Symbol:	A	B	D	D1	E	L	L1	a	b	c	d
<b>Min:</b>	6.10	9.00	8.10	7.42	3.10	0.50	3.00	1.50	0.85	0.40	2.54 BSC
<b>Max:</b>	6.68	9.50	10.9	7.82	3.55	0.70	3.60	1.55	0.90	0.50	

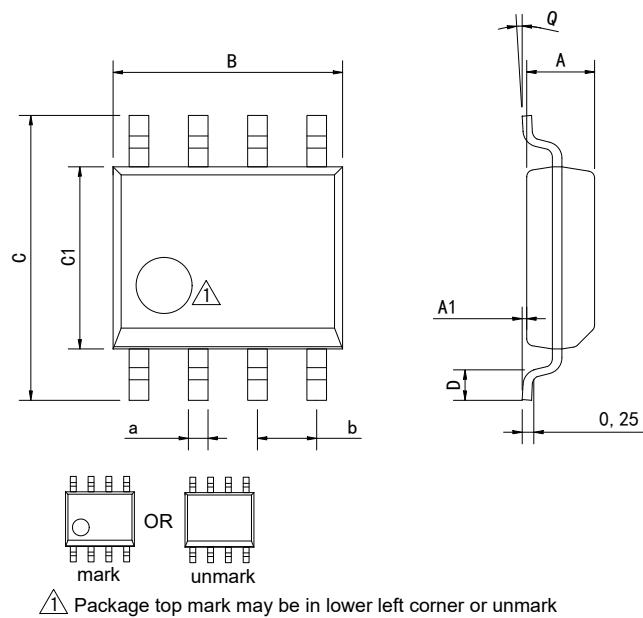
### DIP-14



Dimensions In Millimeters(DIP-14)											
Symbol:	A	B	D	D1	E	L	L1	a	c	d	
<b>Min:</b>	6.10	18.94	8.10	7.42	3.10	0.50	3.00	1.50	0.40	2.54 BSC	
<b>Max:</b>	6.68	19.56	10.9	7.82	3.55	0.70	3.60	1.55	0.50		

## Physical Dimensions

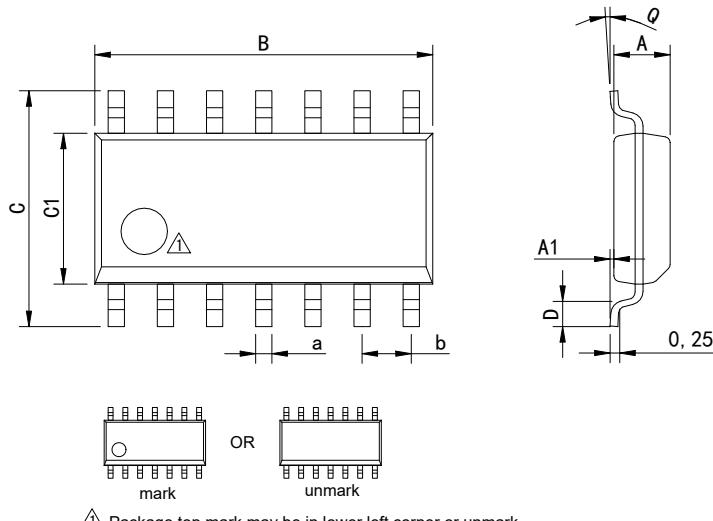
SOP-8



### Dimensions In Millimeters(SOP-8)

Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.35	0.05	4.90	5.80	3.80	0.40	0°	0.35	1.27 BSC
Max:	1.55	0.20	5.10	6.20	4.00	0.80	8°	0.45	

SOP-14

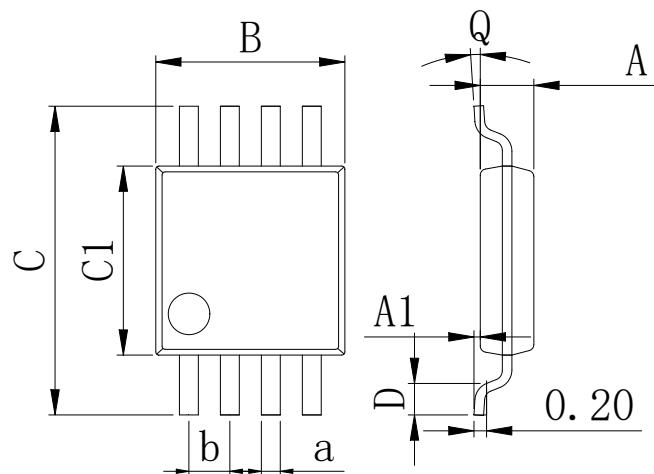


### Dimensions In Millimeters(SOP-14)

Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.35	0.05	8.55	5.80	3.80	0.40	0°	0.35	1.27 BSC
Max:	1.55	0.20	8.75	6.20	4.00	0.80	8°	0.45	

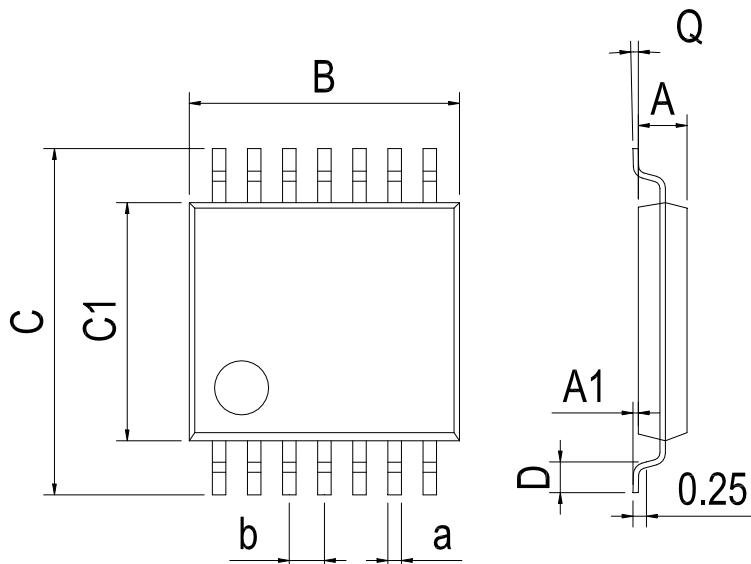
## Physical Dimensions

MSOP-8



Dimensions In Millimeters(MSOP-8)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	0.80	0.05	2.90	4.75	2.90	0.35	0°	0.25	0.65 BSC
Max:	0.90	0.20	3.10	5.05	3.10	0.75	8°	0.35	

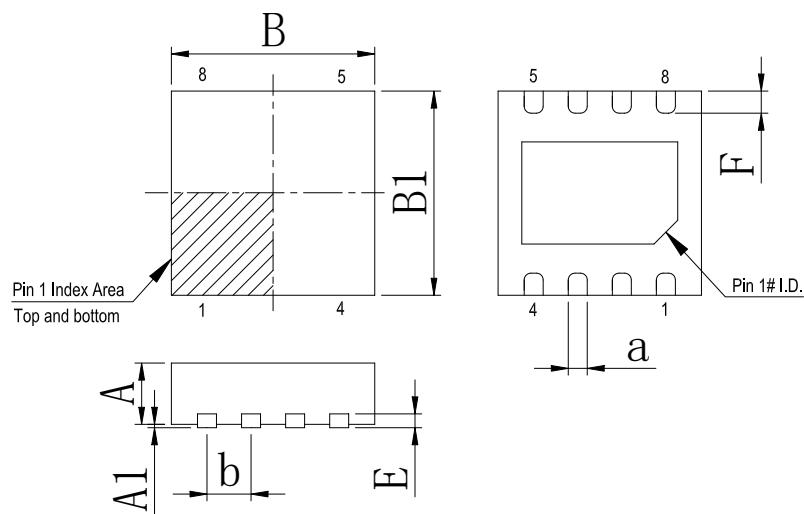
TSSOP-14



Dimensions In Millimeters(TSSOP-14)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	0.85	0.05	4.90	6.20	4.30	0.40	0°	0.20	0.65 BSC
Max:	0.95	0.20	5.10	6.60	4.50	0.80	8°	0.25	

## Physical Dimensions

DFN-8 3\*3



Dimensions In Millimeters(DFN-8 3*3)								
Symbol:	A	A1	B	B1	E	F	a	b
<b>Min:</b>	0.85	0.00	2.90	2.90	0.20	0.30	0.20	0.65 BSC
<b>Max:</b>	0.95	0.05	3.10	3.10	0.25	0.50	0.34	

## Revision History

REVISION NUMBER	DATE	REVISION	PAGE
V1.0	2017-1	New	1-23
V1.1	2025-1	Document Reformatting	1-23
V1.2	2025-6	Add Operating Temperature Range, Updated package marking	4、1
V1.3	2025-8	Add DFN-8 3*3 Package	1
V1.4	2025-12	Update important statements、Update SOP-8 and SOP-14 Dimension drawing	20、24

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