

# MAX3483AE/MAX3485AE/ MAX3488AE/MAX3490AE/ MAX3491AE

**+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers**

## General Description

Devices in the MAX3483AE family (MAX3483AE/MAX3485AE/MAX3488AE/MAX3490AE/MAX3491AE) are  $\pm 20\text{kV}$  ESD-protected RS-485/422 transceivers, optimized for extended cable runs in noisy environments. All devices operate from a single 3.3V supply.

The MAX3483AE and MAX3485AE are half-duplex transceivers. The MAX3488AE, MAX3490AE, and MAX3491AE are full-duplex transceivers. The MAX3483AE/85AE have a 1-unit load receiver input impedance, allowing up to 32 transceivers on the bus. The MAX3488AE/90AE/91AE have a 1/4-unit load receiver input impedance, allowing up to 128 transceivers on the bus. Each transceiver includes a fail-safe receiver, ensuring that the receiver output (RO) is high when inputs are shorted, open, or connected to a three-state bus.

All devices feature enhanced electrostatic discharge (ESD) protection. All transmitter outputs and receiver inputs are protected to  $\pm 20\text{kV}$  HBM ESD,  $\pm 15\text{kV}$  Air-Gap ESD and  $\pm 8\text{kV}$  Contact ESD in accordance to IEC 61000-4-2.

The MAX3483AE, MAX3485AE, MAX3488AE, and MAX3490AE are available in industry standard 8-pin SO package, while the MAX3491AE is available in a 14-pin SO package.

## Benefits and Features

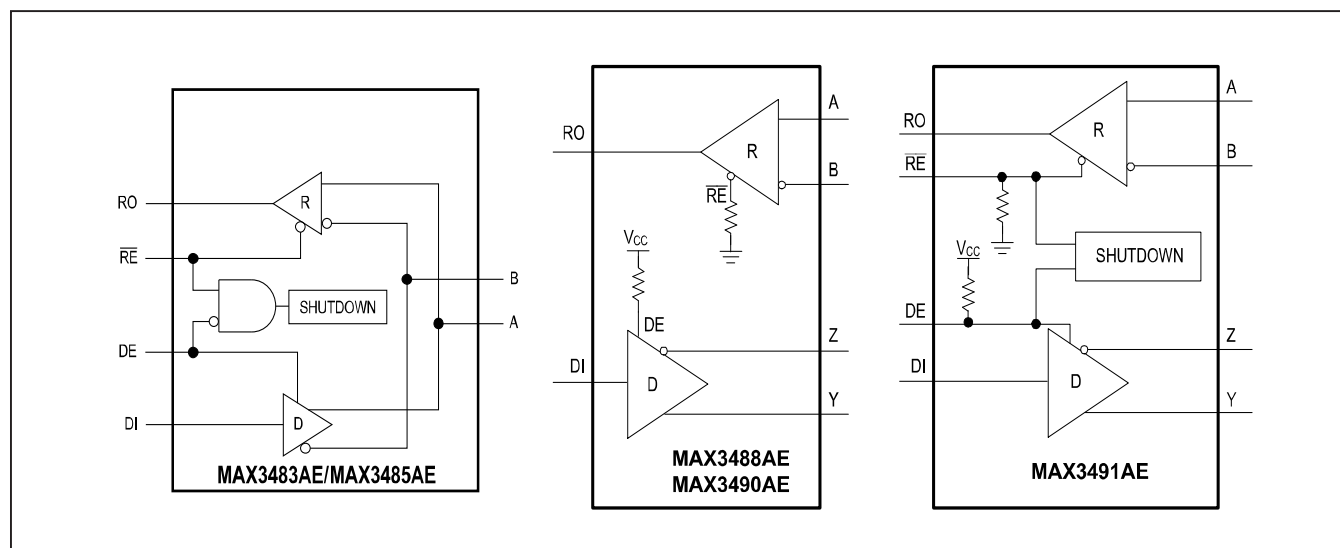
- Integrated Protection Increases Robustness
  - High ESD Protection
    - $\pm 20\text{kV}$  HBM ESD per JEDEC JS-001-2012
    - $\pm 15\text{kV}$  Air Gap per IEC 61000-4-2
    - $\pm 8\text{kV}$  Contact ESD per IEC 61000-4-2
  - Short-Circuit Protected Outputs
  - True Fail-Safe Receiver Prevents False Transition on Receiver Input Short or Open Events
  - Hot-Swap Capability Eliminates False Transitions During Power-Up or Hot Insertion
- High-Speed Data Rates up to 20Mbps
- Up to  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  Operating Temperature
- Allows Up to 128 Transceivers on the Bus

## Applications

- Industrial-Control Local Area Networks
- Transceivers for EMI-Sensitive Applications
- Telecommunications

**Ordering Information** appears at end of data sheet.

## Functional Diagram



# MAX3483AE/MAX3485AE/ MAX3488AE/MAX3490AE/ MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

## Absolute Maximum Ratings

(Voltages referenced to GND.)

$V_{CC}$	-0.3V to +4.0V
RO	-0.3V to ( $V_{CC} + 0.3\text{V}$ )
$\overline{RE}$ , DE, DI	-0.3V to +4.0V
A, B, Y, Z	-9.0V to +13.0V
Short-Circuit Duration (RO, A, B, Y, Z) to GND	Continuous
Operating Temperature Range	
MAX3483AE/85AE/88AE/90AE/91AE	-40°C to +125°C
MAX3488AE/90AE	-40°C to +105°C

Junction Temperature	+150°C
Storage Temperature Range	-65°C to +150°C
Continuous Power Dissipation ( $T_A = +70^\circ\text{C}$ )	
8 SO (derate at 7.6mW/°C above +70°C)	606mW
14 SO (derate at 11.9mW/°C above +70°C)	952mW
Lead Temperature (soldering, 10s)	+300°C
Soldering Temperature (reflow)	+260°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.

## Package Thermal Characteristics (Note 1)

Junction-to-Case Thermal Resistance ( $\theta_{JC}$ )

8-pin SO	38°C/W
14-pin SO	34°C/W

Junction-to-Ambient Thermal Resistance ( $\theta_{JA}$ )

8-pin SO	132°C/W
14-pin SO	84°C/W

**Note 1:** Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to [www.maximintegrated.com/thermal-tutorial](http://www.maximintegrated.com/thermal-tutorial).

## Electrical Characteristics

( $V_{CC} = +3.0\text{V}$  to  $+3.6\text{V}$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are at  $V_{CC} = +3.3\text{V}$  and  $T_A = +25^\circ\text{C}$ .) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>POWER SUPPLY</b>						
Supply Voltage	$V_{CC}$		3.0		3.6	V
Supply Current	$I_{CC}$	DE = $V_{CC}$ , $\overline{RE} = \text{GND}$ , no load		1.9	4	mA
		DE = 0, $\overline{RE} = 0$ , no load, DI = 0 or $V_{CC}$	1.2		4.0	
Shutdown Supply Current	$I_{SHDN}$	DE = GND, $\overline{RE} = V_{CC}$ , MAX3483AE/85AE/91AE			10	$\mu\text{A}$
<b>DRIVER</b>						
Differential Driver Output	$V_{OD}$	$V_{CC} = 3\text{V}$ , $R_L = 100\Omega$ , Figure 1	2.0			V
		$V_{CC} = 3\text{V}$ , $R_L = 54\Omega$ , Figure 1	1.5			
Change in Magnitude of Differential Output Voltage	$\Delta V_{OD}$	$R_L = 54\Omega$ or $100\Omega$ , Figure 1 (Note 4)	-0.2		+0.2	V
Driver Common-Mode Output Voltage	$V_{OC}$	$R_L = 54\Omega$ or $100\Omega$ , Figure 1		$V_{CC}/2$	3	V
Change in Magnitude of Common-Mode Voltage	$\Delta V_{OC}$	$R_L = 54\Omega$ or $100\Omega$ , Figure 1 (Note 4)	-0.2		+0.2	V
Single-Ended Driver Output High	$V_{OH}$	A or B output, $I_A$ or $I_B = -20\text{mA}$	2.2			V
Single-Ended Driver Output Low	$V_{OL}$	A or B output, $I_A$ or $I_B = 20\text{mA}$			0.8	V
Driver Short-Circuit Output Current	$I_{OSD}$	$V_{OUT} = -7\text{V}$	-250			mA
		$V_{OUT} = +12\text{V}$			250	mA

MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

## Electrical Characteristics (continued)

( $V_{CC} = +3.0\text{V}$  to  $+3.6\text{V}$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are at  $V_{CC} = +3.3\text{V}$  and  $T_A = +25^\circ\text{C}$ .) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
RECEIVER							
Input Current	I <sub>A, B</sub>	DE = GND, V <sub>CC</sub> = GND or +3.6V	V <sub>IN</sub> = +12V	430	1000	μA	
			V <sub>IN</sub> = -7V	-450	-300		
Differential Input Capacitance	C <sub>A, B</sub>	Between A and B, DE = GND, f = 4MHz			12	pF	
Receiver Differential Threshold Voltage	V <sub>TH</sub>	-7V ≤ V <sub>CM</sub> ≤ +12V		-200	-105	-10	mV
Receiver Input Hysteresis	ΔV <sub>TH</sub>	V <sub>CM</sub> = 0V		10		mV	
Receiver Input Resistance	R <sub>IN</sub>	-7V ≤ V <sub>CM</sub> ≤ +12V	MAX3483AE/85AE	12	kΩ		
			MAX3488AE/90AE/91AE	48			
LOGIC INTERFACE (DI, DE, $\overline{\text{RE}}$ , RO)							
Input Voltage High	V <sub>IH</sub>	DE, DI, $\overline{\text{RE}}$		2.0		V	
Input Voltage Low	V <sub>IL</sub>	DE, DI, $\overline{\text{RE}}$		0.8		V	
Input Hysteresis	V <sub>HYS</sub>	DE, DI, $\overline{\text{RE}}$		50		mV	
Input Current	I <sub>IN</sub>	DE, DI, $\overline{\text{RE}}$		±2		μA	
Input Impedance on First Transition		DE, $\overline{\text{RE}}$		1		10	kΩ
RO Output Voltage High	V <sub>OHRO</sub>	$\overline{\text{RE}}$ = GND, I <sub>RO</sub> = -2mA, (V <sub>A</sub> - V <sub>B</sub> ) > 200mV		V <sub>CC</sub> - 1.5		V	
RO Output Voltage Low	V <sub>OLRO</sub>	$\overline{\text{RE}}$ = GND, I <sub>RO</sub> = 2mA, (V <sub>A</sub> - V <sub>B</sub> ) < -200mV		0.4		V	
Receiver Three-State Output Current	I <sub>OZR</sub>	$\overline{\text{RE}}$ = V <sub>CC</sub> , 0 ≤ V <sub>RO</sub> ≤ V <sub>CC</sub>		±1		μA	
$\overline{\text{RE}}$ Pulldown and DE Pullup Resistance	R <sub>IN</sub>			1		MΩ	
Receiver Output Short-Circuit Current	I <sub>OSR</sub>	0 ≤ V <sub>RO</sub> ≤ V <sub>CC</sub>		±110		mA	
PROTECTION							
Thermal Shutdown Threshold	T <sub>SHDN</sub>	Temperature rising		+160		°C	
Thermal Shutdown Hysteresis				15		°C	
ESD Protection on A, B, Z, and Y Pins		IEC 61000-4-2 Air Gap Discharge to GND		±15		kV	
		IEC 61000-4-2 Contact Discharge to GND		±8			
		Human Body Model to GND		±20			
ESD Protection, All Other Pins		Human Body Model		±2		kV	

MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

## Switching Characteristics MAX3485AE/MAX3490AE/MAX3491AE

( $V_{CC} = +3\text{V}$  to  $+3.6\text{V}$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are at  $V_{CC} = +3.3\text{V}$  and  $T_A = +25^\circ\text{C}$ .) (Notes 2, 3, 5)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DRIVER</b>						
Driver Propagation Delay	$t_{DPLH}$	$R_L = 54\Omega$ , $C_L = 50\text{pF}$ , Figures 2 and 3			30	ns
	$t_{DPLH}$				30	
Driver Differential Output Rise or Fall Time	$t_{HL}$ , $t_{LH}$	$R_L = 54\Omega$ , $C_L = 50\text{pF}$ , Figures 2 and 3			7	ns
Differential Driver Output Skew $ t_{DPLH} - t_{DPLH} $	$t_{DSKEW}$	$R_L = 54\Omega$ , $C_L = 50\text{pF}$ , Figures 2 and 3 (Note 6)			3	ns
Maximum Data Rate	$DR_{MAX}$		20			Mbps
Driver Enable to Output High	$t_{DZH}$	$R_L = 110\Omega$ , $C_L = 50\text{pF}$ , MAX3485AE, MAX3491AE Figures 4 and 5 (Note 7)			40	ns
Driver Enable to Output Low	$t_{DZL}$	$R_L = 110\Omega$ , $C_L = 50\text{pF}$ , MAX3485AE, MAX3491AE Figures 4 and 5 (Note 7)			40	ns
Driver Disable Time from Low	$t_{DLZ}$	$R_L = 110\Omega$ , $C_L = 50\text{pF}$ , MAX3485AE, MAX3491AE Figures 4 and 5			40	ns
Driver Disable Time from High	$t_{DHZ}$	$R_L = 110\Omega$ , $C_L = 50\text{pF}$ , MAX3485AE, MAX3491AE Figures 4 and 5			40	ns
Driver Enable from Shutdown to Output High	$t_{DLZ}(SHDN)$	$R_L = 110\Omega$ , $C_L = 15\text{pF}$ , MAX3485AE, Figures 4 and 5 (Note 7)			6	$\mu\text{s}$
		$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3491AE, Figure 8			100	$\mu\text{s}$
Driver Enable from Shutdown to Output Low	$t_{DZH}(SHDN)$	$R_L = 110\Omega$ , $C_L = 15\text{pF}$ , MAX3485AE Figures 4 and 5 (Note 7)			6	$\mu\text{s}$
Time to Shutdown	$t_{SHDN}$	(Note 8)	50		800	ns
<b>RECEIVER</b>						
Receiver Propagation Delay	$t_{RPLH}$	$C_L = 15\text{pF}$ , Figures 6 and 7			35	ns
	$t_{RPHL}$				35	
Receiver Output Skew	$t_{RSKEW}$	$C_L = 15\text{pF}$ , Figures 6 and 7 (Note 6)			2	ns
Maximum Data Rate	$DR_{MAX}$		20			Mbps
Receiver Enable to Output High	$t_{RZH}$	$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3485AE, MAX3491AE, Figure 8 (Note 7)			40	ns
Receiver Enable to Output Low	$t_{RZL}$	$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3485AE, MAX3491AE, Figure 8 (Note 7)			40	ns
Receiver Disable Time from Low	$t_{RLZ}$	$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3485AE, MAX3491AE, Figure 8			40	ns

MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

### Switching Characteristics MAX3485AE/MAX3490AE/MAX3491AE (continued)

( $V_{CC} = +3\text{V}$  to  $+3.6\text{V}$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are at  $V_{CC} = +3.3\text{V}$  and  $T_A = +25^\circ\text{C}$ .) (Notes 2, 3, 5)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Receiver Disable Time from High	$t_{RHZ}$	$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3485AE, MAX3491AE, Figure 8			40	ns
Receiver Enable from Shutdown to Output High	$t_{RLZ}(SHDN)$	$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3485AE, Figure 8 (Note 7)			6	$\mu\text{s}$
		$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3491AE, Figure 8			100	$\mu\text{s}$
Receiver Enable from Shutdown to Output Low	$t_{RHZ}(SHDN)$	$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3485AE, Figure 8 (Note 7)			6	$\mu\text{s}$
		$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3491AE, Figure 8			100	$\mu\text{s}$
Time to Shutdown	$t_{SHDN}$	(Note 8)	50		800	ns

### Switching Characteristics (MAX3483AE/MAX3488AE)

( $V_{CC} = +3\text{V}$  to  $+3.6\text{V}$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are at  $V_{CC} = +3.3\text{V}$  and  $T_A = +25^\circ\text{C}$ .) (Notes 2, 3, 5)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DRIVER</b>						
Driver Propagation Delay	$t_{DPLH}$	$R_L = 54\Omega$ , $C_L = 50\text{pF}$ , Figures 2 and 3			1000	ns
	$t_{DPLH}$				1000	
Driver Differential Output Rise or Fall Time	$t_{HL}$ , $t_{LH}$	$R_L = 54\Omega$ , $C_L = 50\text{pF}$ , Figures 2 and 3	200		900	ns
Differential Driver Output Skew $ t_{DPLH} - t_{DPLH} $	$t_{DSKEW}$	$R_L = 54\Omega$ , $C_L = 50\text{pF}$ , Figures 2 and 3			140	ns
Maximum Data Rate	$DR_{MAX}$		250			kbps
Driver Enable to Output High	$t_{DZH}$	$R_L = 110\Omega$ , $C_L = 50\text{pF}$ , MAX3483AE Figures 4 and 5 (Note 6)			2500	ns
Driver Enable to Output Low	$t_{DZL}$	$R_L = 110\Omega$ , $C_L = 50\text{pF}$ , MAX3483AE Figures 4 and 5 (Note 6)			2500	ns
Driver Disable Time from Low	$t_{DLZ}$	$R_L = 110\Omega$ , $C_L = 50\text{pF}$ , MAX3483AE Figures 4 and 5			100	ns
Driver Disable Time from High	$t_{DHZ}$	$R_L = 110\Omega$ , $C_L = 50\text{pF}$ , MAX3483AE Figures 4 and 5			100	ns
Driver Enable from Shutdown to Output High	$t_{DLZ}(SHDN)$	$R_L = 110\Omega$ , $C_L = 15\text{pF}$ , MAX3483AE Figures 4 and 5 (Note 6)			10	$\mu\text{s}$

MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

### Switching Characteristics (MAX3483AE/MAX3488AE) (continued)

( $V_{CC} = +3\text{V}$  to  $+3.6\text{V}$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are at  $V_{CC} = +3.3\text{V}$  and  $T_A = +25^\circ\text{C}$ .) (Notes 2, 3, 5)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Driver Enable from Shutdown to Output Low	$t_{DZH}(\text{SHDN})$	$R_L = 110\Omega$ , $C_L = 15\text{pF}$ , MAX3483AE Figures 4 and 5 (Note 6)			5.5	$\mu\text{s}$
Time to Shutdown	$t_{SHDN}$	(Note 8) MAX3483AE	50	340	700	ns
<b>RECEIVER</b>						
Receiver Propagation Delay	$t_{RPLH}$	$C_L = 15\text{pF}$ , Figures 6 and 7			200	ns
	$t_{RPHL}$				200	
Receiver Output Skew	$t_{RSKEW}$	$C_L = 15\text{pF}$ , Figures 6 and 7 (Note 6)			30	ns
Maximum Data Rate	$DR_{MAX}$		250			kbps
Receiver Enable to Output High	$t_{RZH}$	$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3483AE Figure 8 (Note 6)			50	ns
Receiver Enable to Output Low	$t_{RZL}$	$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3483AE Figure 8 (Note 6)			50	ns
Receiver Disable Time from Low	$t_{RLZ}$	$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3483AE Figure 8			50	ns
Receiver Disable Time from High	$t_{RHZ}$	$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3483AE Figure 8			50	ns
Receiver Enable from Shutdown to Output High	$t_{RLZ}(\text{SHDN})$	$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3483AE Figure 8 (Note 6)			10	$\mu\text{s}$
Receiver Enable from Shutdown to Output Low	$t_{RHZ}(\text{SHDN})$	$R_L = 1\text{k}\Omega$ , $C_L = 15\text{pF}$ , MAX3483AE Figure 8 (Note 6)			10	$\mu\text{s}$
Time to Shutdown	$t_{SHDN}$	(Note 8) MAX3483AE	50	340	800	ns

**Note 2:** All devices 100% production tested at  $T_A = +25^\circ\text{C}$ . Specifications over temperature are guaranteed by design.

**Note 3:** All currents into the device are positive; all currents out of the device are negative. All voltages are referenced to ground, unless otherwise noted.

**Note 4:**  $\Delta V_{OD}$  and  $\Delta V_{OC}$  are the changes in  $V_{OD}$  and  $V_{OC}$ , respectively, when the DI input changes state.

**Note 5:** Capacitive load includes test probe and fixture capacitance.

**Note 6:** Guaranteed by design; not production tested.

**Note 7:** The timing parameter refers to the driver or receiver enable delay, when the device has exited the initial hot-swap protect state and is in normal operating mode.

**Note 8:** Shutdown is enabled by driving  $\overline{RE}$  high and DE low. The device is guaranteed to have entered shutdown after  $t_{SHDN}$  has elapsed.

MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

## +3.3V-Powered, $\pm 20\text{kV}$ ESD-Protected, 20Mbps and Slew-Rate-Limited RS-485/RS-422 Transceivers

## Test and Timing Diagrams

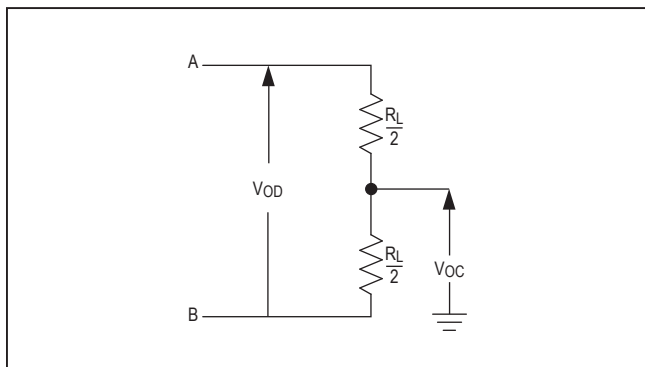


Figure 1. Driver DC Test Load

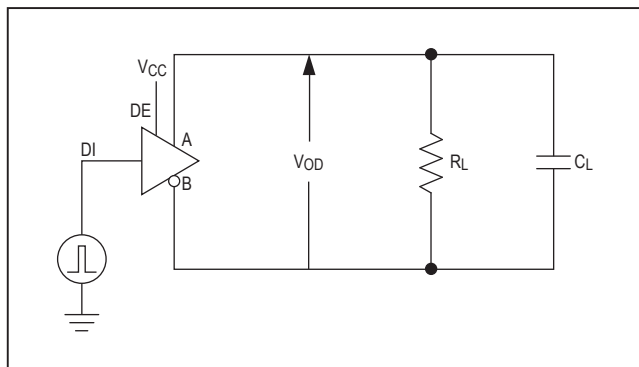


Figure 2. Driver Timing Test Circuit

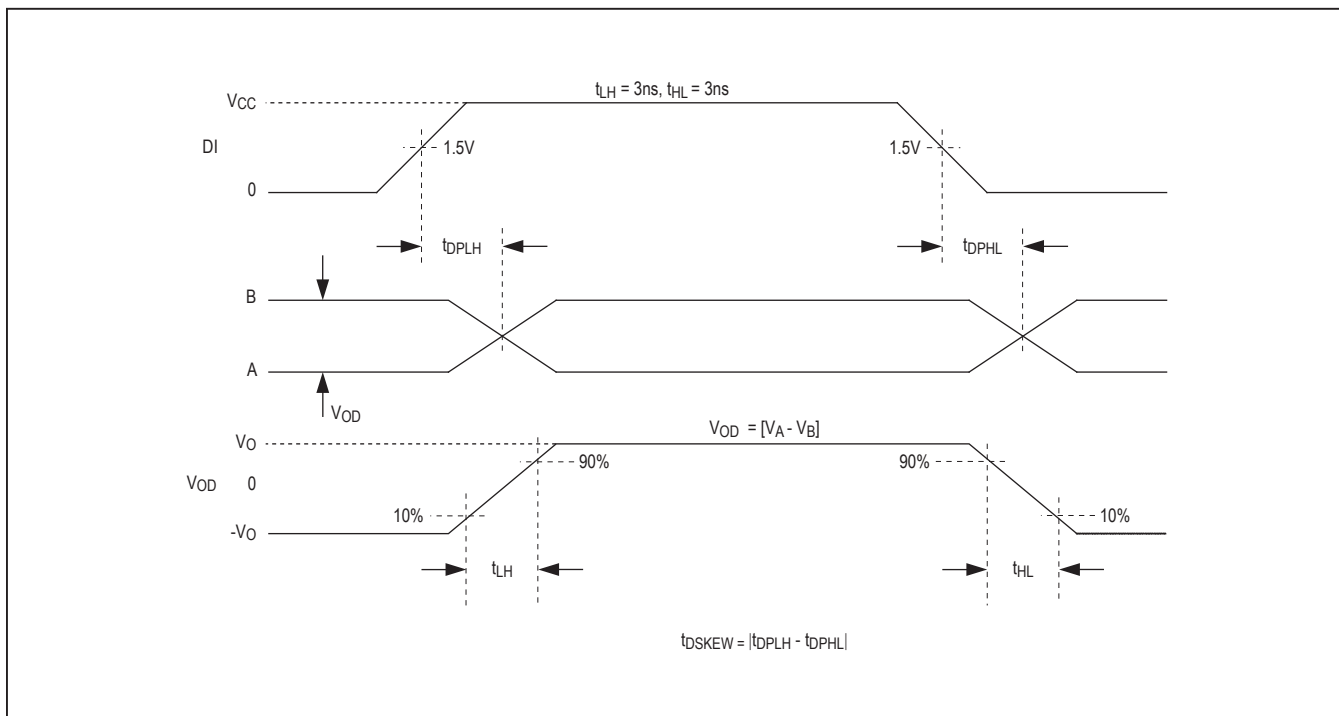


Figure 3. Driver Propagation Delays

MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

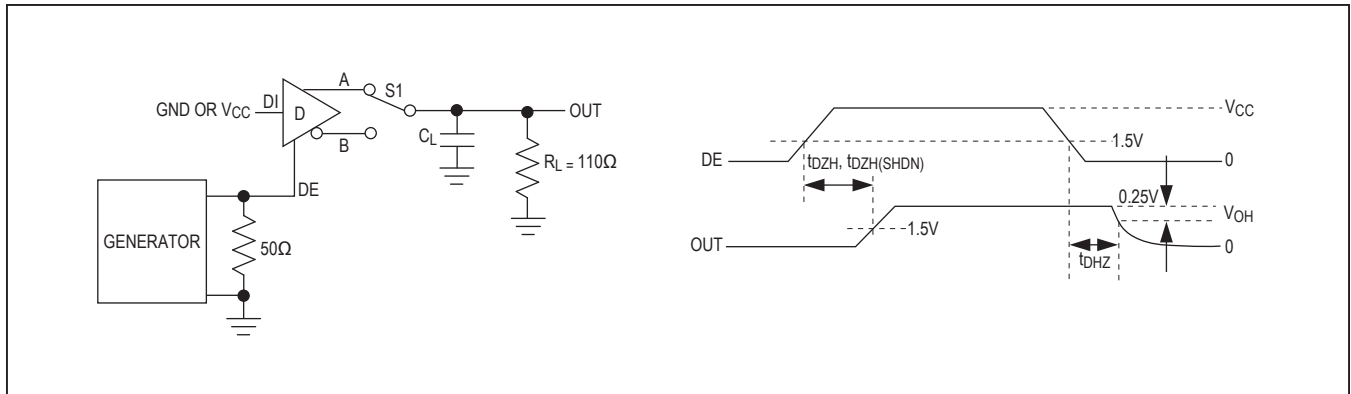


Figure 4. Driver Enable and Disable Times ( $t_{DZH}$ ,  $t_{DHZ}$ )

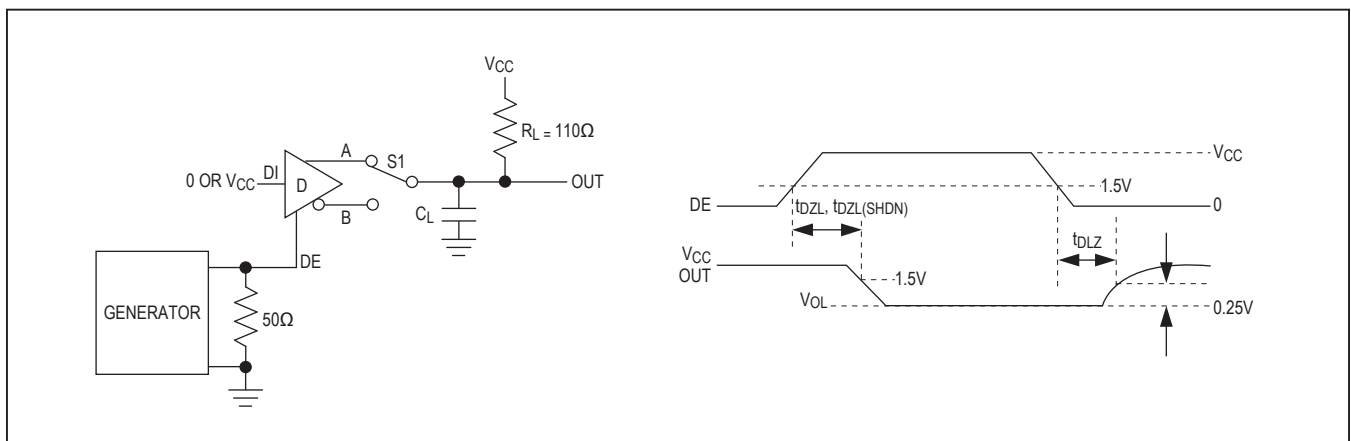


Figure 5. Driver Enable and Disable Times ( $t_{DZL}$ ,  $t_{DLZ}$ )

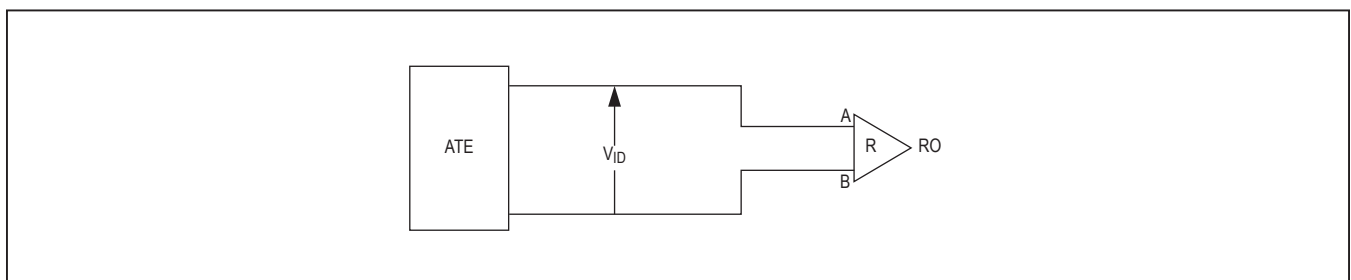


Figure 6. Receiver Propagation Delay Test Circuit



MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

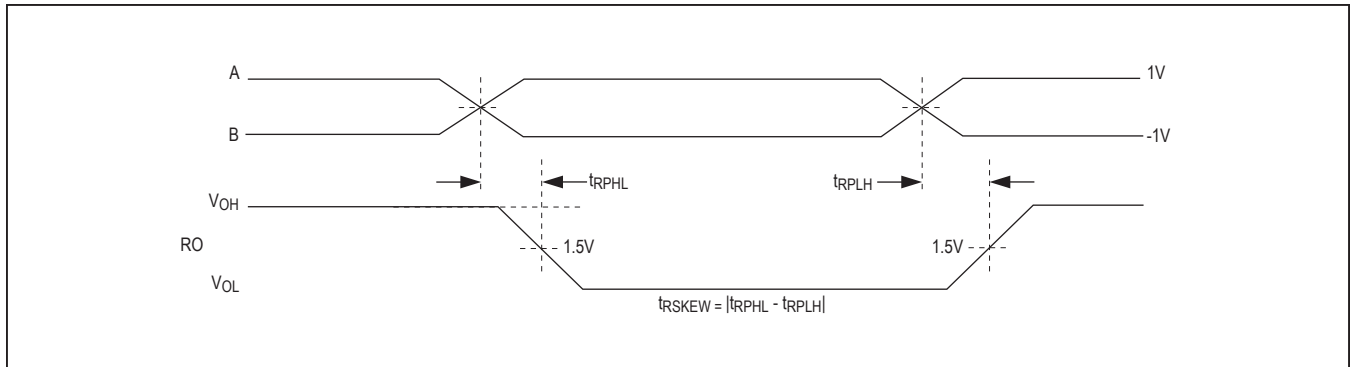


Figure 7. Receiver Propagation Delays

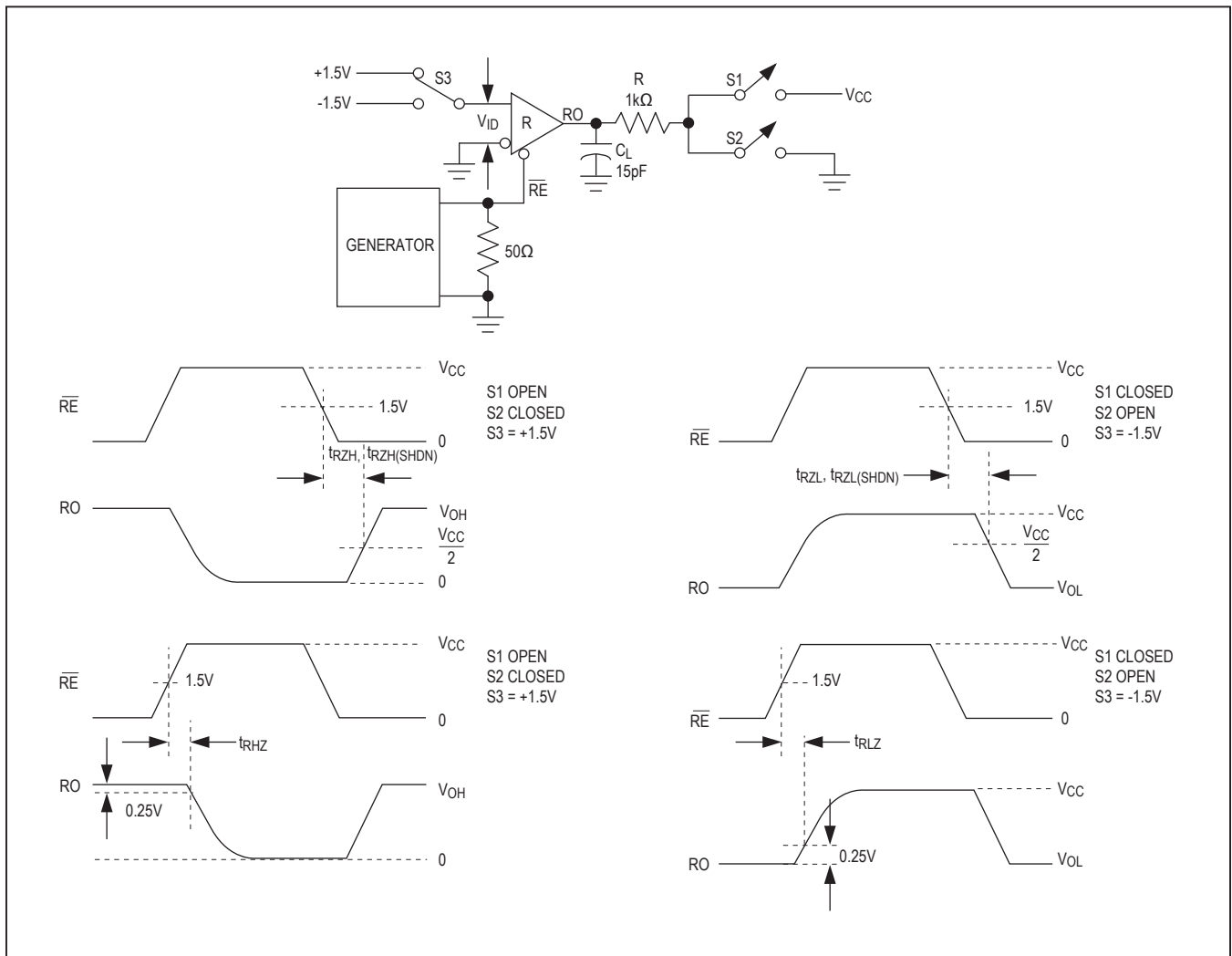


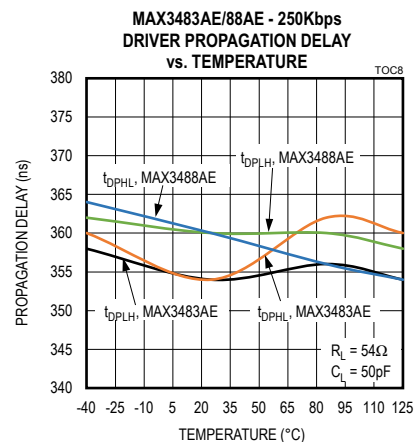
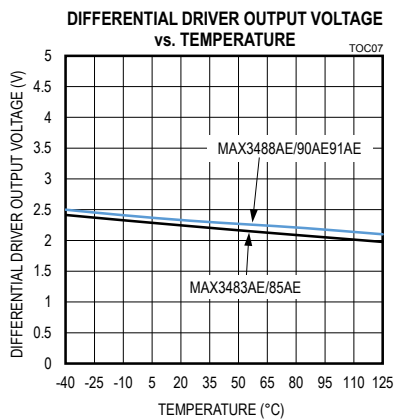
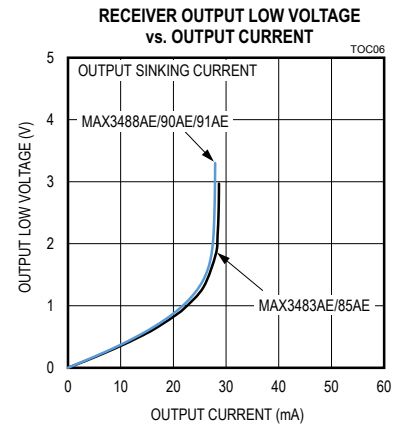
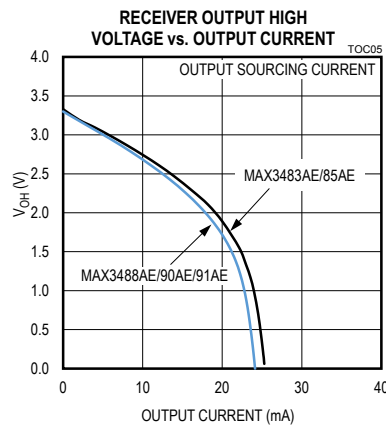
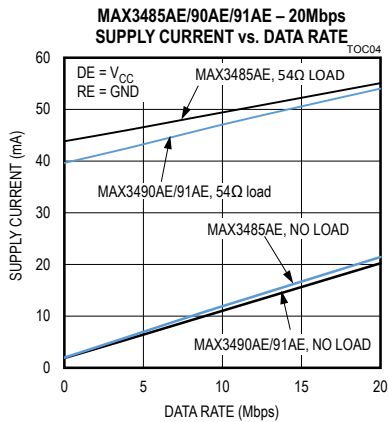
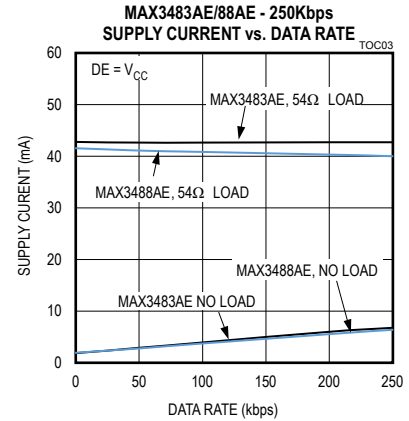
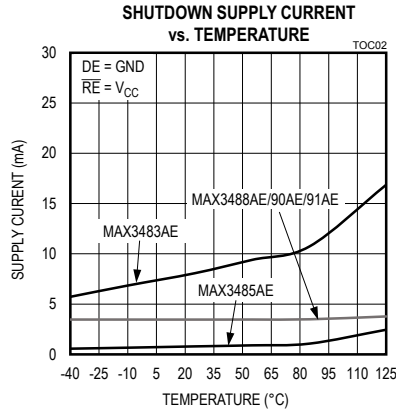
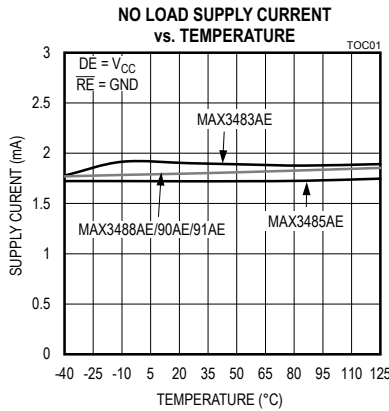
Figure 8. Receiver Enable and Disable Times

# MAX3483AE/MAX3485AE/ MAX3488AE/MAX3490AE/ MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

## Typical Operating Characteristics

( $V_{CC} = +3.3\text{V}$ ,  $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

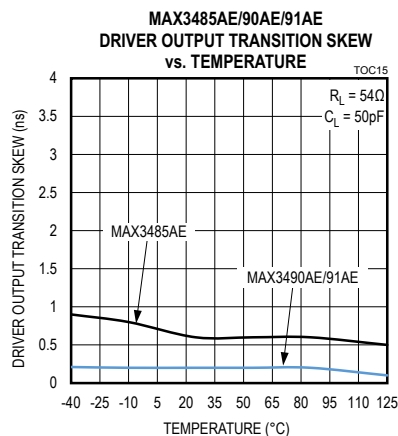
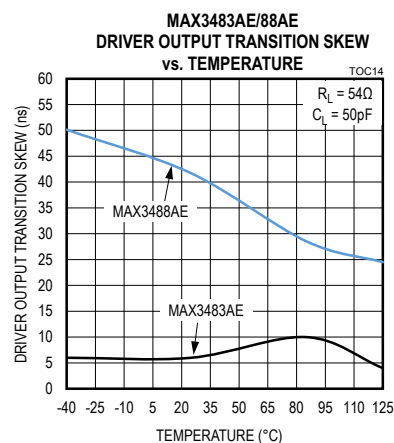
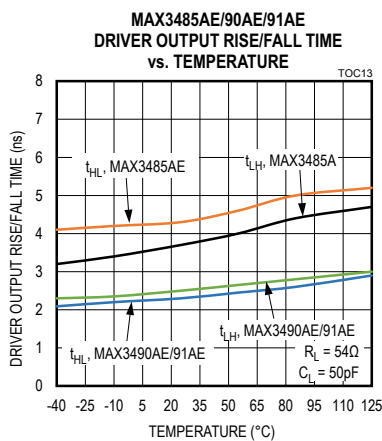
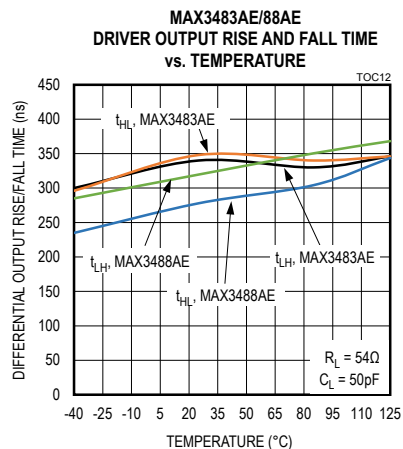
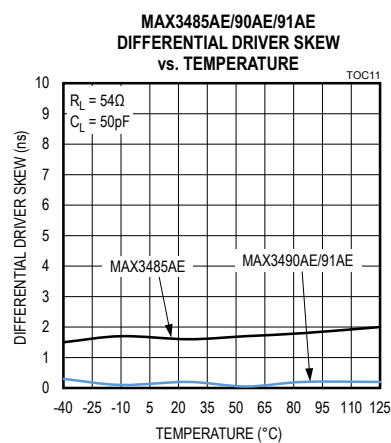
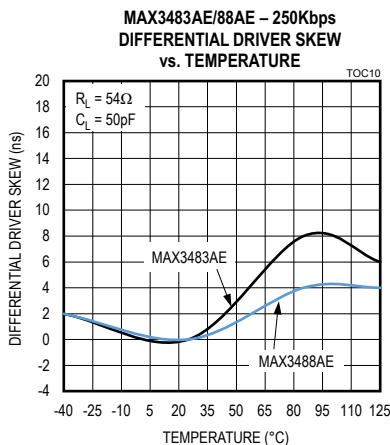
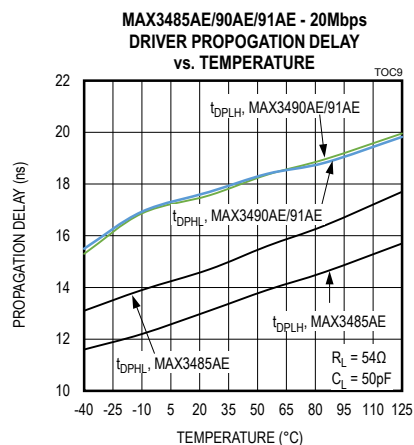


MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

Typical Operating Characteristics (continued)

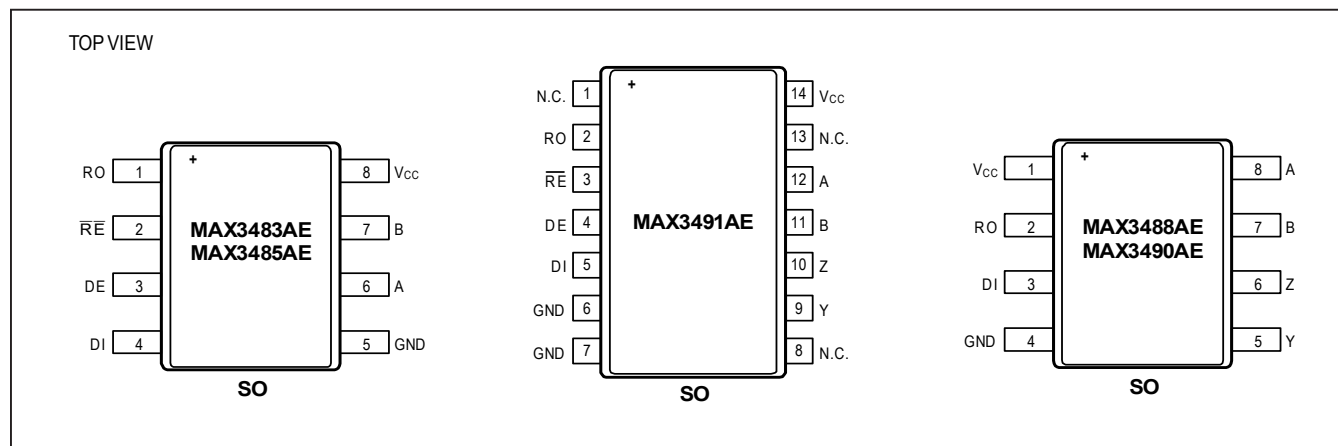
( $V_{CC} = +3.3\text{V}$ ,  $T_A = +25^\circ\text{C}$ , unless otherwise specified.)



MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

## Pin Configuration



## Pin Description

PIN			NAME	FUNCTION
MAX3483AE MAX3485AE	MAX3488AE MAX3490AE	MAX3491AE		
—	—	1, 8, 13	N.C.	No Connection. Not internally connected.
1	2	2	RO	Receiver Output. Drive $\overline{\text{RE}}$ low to enable RO. RO is always active on the MAX3488AE and MAX3490AE. RO is high when the receiver inputs ( $V_A - V_B$ ) $> -10\text{mV}$ and low when ( $V_A - V_B$ ) $\leq 200\text{mV}$ . See the Function Tables.
2	—	3	$\overline{\text{RE}}$	Receiver Output Enable. Drive $\overline{\text{RE}}$ low, or leave unconnected, to enable RO. RO is high impedance when $\overline{\text{RE}}$ is high. Drive $\overline{\text{RE}}$ high and DE low to enter low-power shutdown mode. $\overline{\text{RE}}$ has a weak pulldown to GND.
3	—	4	DE	Driver Enable. Drive DE high, or leave unconnected, to enable the driver outputs (Y and Z for full duplex, A and B for half duplex). The driver outputs are high impedance when DE is low. Drive $\overline{\text{RE}}$ high and DE low to enter low-power shutdown mode. DE has a weak pullup to $V_{\text{CC}}$ .
4	3	5	DI	Driver Input. A low on DI forces the noninverting output (Y or A) low and the inverting output (Z or B) high. Similarly, a high on DI forces the noninverting output (Y or A) high and the inverting output (Z or B) low. See the Function Tables.
5	4	6, 7	GND	Ground
—	5	9	Y	Noninverting Driver Output
—	6	10	Z	Inverting Driver Output
7	7	11	B	Inverting Receiver Input/Driver Output (MAX3483AE/MAX3485AE). Inverting Receiver Input (MAX3488AE/MAX3490AE/MAX3491AE).
6	8	12	A	Noninverting Receiver Input/Driver Output (MAX3483AE/MAX3485AE). Noninverting Receiver Input (MAX3488AE/MAX3490AE/MAX3491AE).
8	1	14	$V_{\text{CC}}$	Positive Supply. Bypass $V_{\text{CC}}$ to GND with a $0.1\mu\text{F}$ capacitor as close as possible to the IC.

MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

### Function Tables (MAX3483AE, MAX3485AE)

TRANSMITTING					
INPUTS			OUTPUTS		MODE
$\overline{\text{RE}}$	DE	DI	B	A	
X	1	1	0	1	Active
X	1	0	1	0	Active
0	0	X	High Impedance		Driver Disabled
1	0	X	High Impedance		Shutdown

RECEIVING				
INPUTS			OUTPUTS	MODE
$\overline{\text{RE}}$	DE	A-B	RO	
0	X	$\geq -10\text{mV}$	1	Active
0	X	$\leq -200\text{mV}$	0	Active
0	X	Open/Shorted	1	Active
1	1	X	High Impedance	Receiver Disabled
1	0	X	High Impedance	Shutdown

X = Don't care

### Function Tables MAX3491AE

TRANSMITTING				
INPUTS			OUTPUTS	
$\overline{\text{RE}}^*$	DE*	DI	Y	Z
X	1	1	1	0
X	1	0	0	1
0	0	X	High-Impedance	
1	0	X	Shutdown	

RECEIVING			
INPUTS			OUTPUT
$\overline{\text{RE}}^*$	DE*	$V_A - V_B$	RO
0	X	$\geq -10\text{mV}$	1
0	X	$\leq -200\text{mV}$	0
0	X	Open/Shorted	1
1	1	X	High-Impedance
1	0	X	Shutdown

\* $\overline{\text{RE}}$  and DE on the MAX3488AE and MAX3490AE are internal. The driver outputs and receiver are always active in these devices.



## MAX3483AE/MAX3485AE/ MAX3488AE/MAX3490AE/ MAX3491AE

resistor. M2 is designed to pull DE to the disabled state against an external parasitic capacitance up to 100pF that can drive DE high. After 10μs, the timer deactivates M2 while M1 remains on, holding DE low against three-state leakages that can drive DE high. M1 remains on until an external source overcomes the required input current. At this time, the SR latch resets and M1 turns off. When M1 turns off, DE reverts to a standard, high-impedance CMOS input. Whenever  $V_{CC}$  drops below 1V, the hot-swap input is reset.

A complementary circuit employing two pMOS devices pulls RE to  $V_{CC}$ .

### ±20kV 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 have extra protection against static electricity. The ESD structures withstand high ESD in all states: normal operation, shutdown, and powered down. After an ESD event, the transceiver family keeps working without latch-up or damage.

ESD protection can be tested in various ways. The transmitter outputs and receiver inputs are characterized for protection to the following limits:

## +3.3V-Powered, ±20kV ESD-Protected, 20Mbps and Slew-Rate-Limited RS-485/RS-422 Transceivers

- ±20kV HBM using JEDEC JS-001-2014.
- ±15kV using the Air-Gap Discharge method specified in IEC 61000-4-2.
- ±8kV using the Contact Discharge method specified in IEC 61000-4-2.

### ESD Test Conditions

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

### Human Body Model (HBM)

Figure 10 shows the HBM, and Figure 11 shows the current waveform it generates when discharged into a low-impedance state. 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 61000-4-2

The IEC 61000-4-2 standard covers ESD testing and performance of finished equipment. However, it does not specifically refer to integrated circuits. The transceiver family helps in designing equipment to meet IEC 61000-4-2 without the need for additional ESD protection components.

The major difference between tests done using the HBM and IEC 61000-4-2 is higher peak current in IEC 61000-4-2 because series resistance is lower in the IEC 61000-4-2 model. Hence, the ESD withstand voltage measured to IEC 61000-4-2 is generally lower than that measured using the HBM.

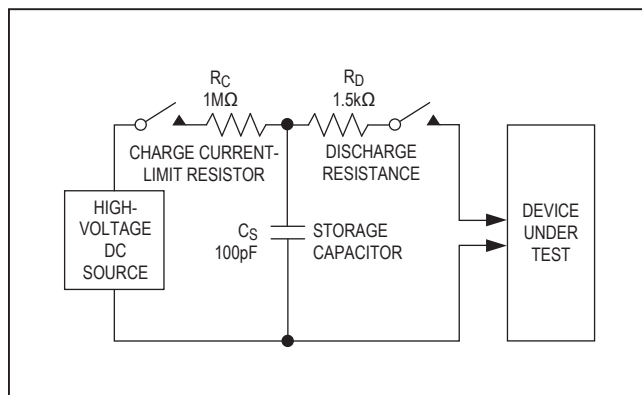


Figure 10. Human Body ESD Test Model

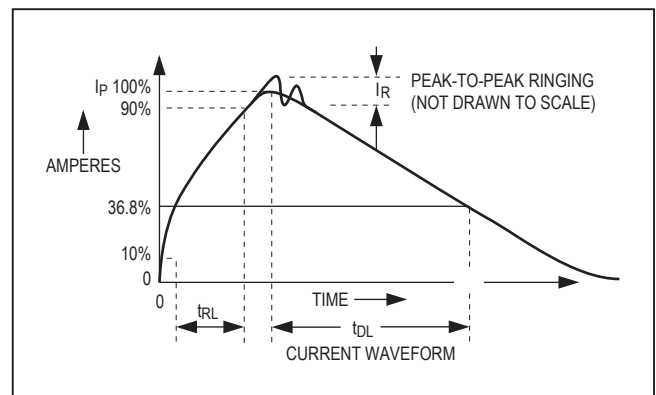


Figure 11. Human Body Current Waveform

# MAX3483AE/MAX3485AE/ MAX3488AE/MAX3490AE/ MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

Figure 12 shows the IEC 61000-4-2 model, and Figure 13 shows the current waveform for IEC 61000-4-2 ESD Contact Discharge test.

## Applications Information

### Driver Output Protection

Two mechanisms prevent excessive output current and power dissipation caused by faults or by bus connection. The first, a current limit on the output stage provides immediate protection against short circuits over the whole common-mode voltage range. The second, a thermal-shutdown circuit, forces the driver outputs into a high-impedance state if the die temperature exceeds  $+160^\circ\text{C}$  (typ).

### Low-Power Shutdown Mode (MAX3483AE, MAX3485AE, MAX3491AE)

Low-power shutdown mode is initiated by bringing  $\overline{\text{RE}}$  high and DE low. In shutdown, the devices draw less than  $10\mu\text{A}$  of supply current.

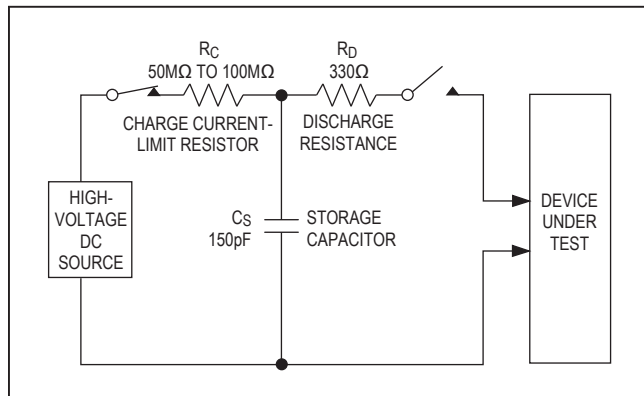


Figure 12. IEC 61000-4-2 ESD Test Model

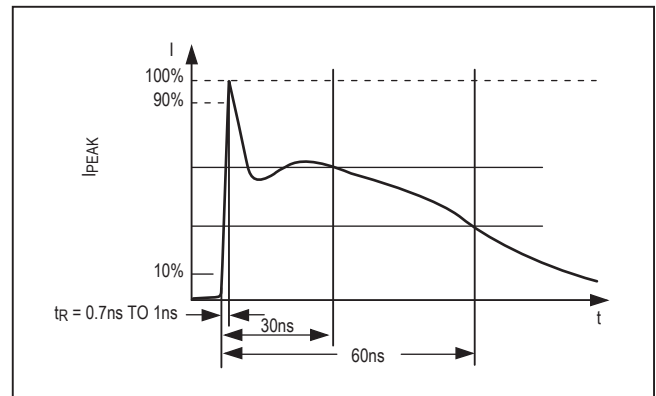


Figure 13. IEC 61000-4-2 ESD Generator Current Waveform

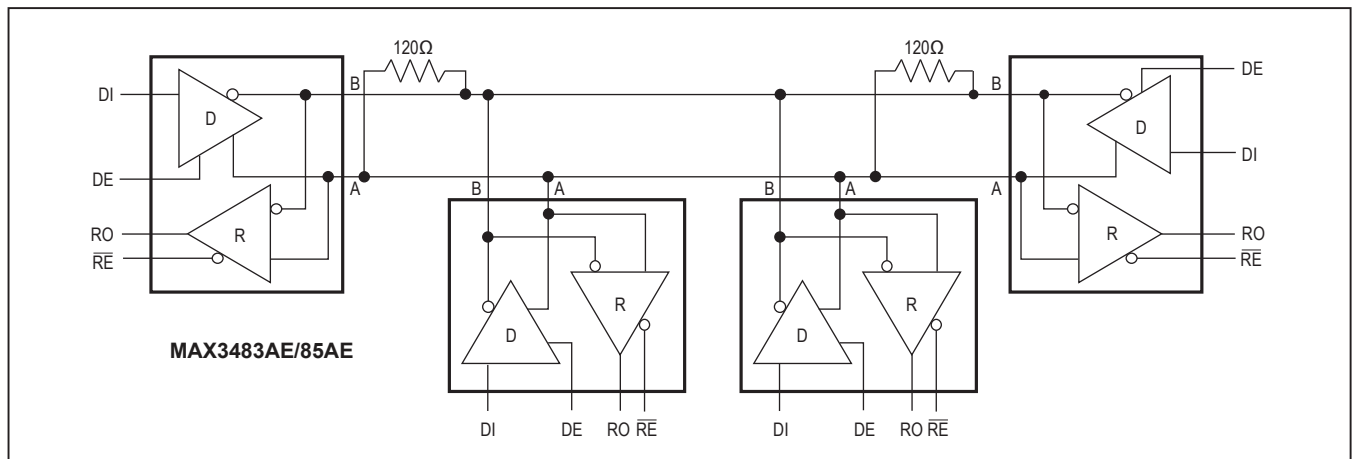


Figure 14. Typical Half-Duplex Application Circuit



MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

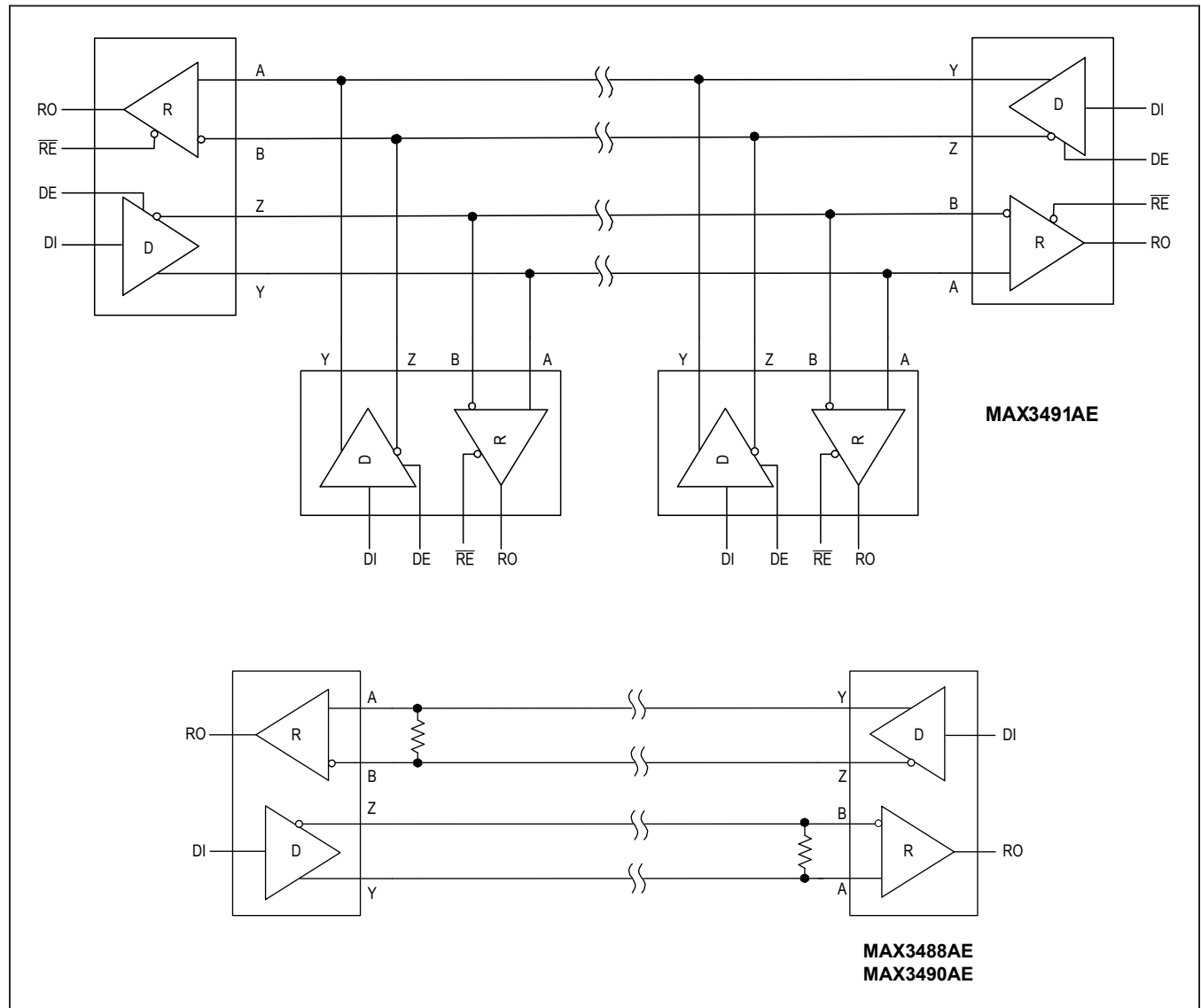


Figure 15. Typical Full-Duplex RS-485 Network

MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

## Chip Information

PROCESS: BiCMOS

## Package Information

For the latest package outline information and land patterns (footprints), go to [www.maximintegrated.com/packages](http://www.maximintegrated.com/packages). Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	OUTLINE NO.	LAND PATTERN NO.
8 SOIC	S8+2	<a href="#">21-0041</a>	<a href="#">90-0096</a>
8 SOIC	S8+4	<a href="#">21-0041</a>	<a href="#">90-0096</a>
14 SOIC	S14+1	<a href="#">21-0041</a>	<a href="#">90-0112</a>

## Ordering Information

PART	DUPLEX	DATA RATE (MAX)	PIN-PACKAGE	PACKAGE CODE	TEMPERATURE RANGE	NODES
MAX3483AEASA+	Half	0.25Mbps	8 SO	S8+2	-40°C to +125°C	32
MAX3485AEASA+	Half	20Mbps	8 SO	S8+2	-40°C to +125°C	32
MAX3488AEGSA+	Full	0.25Mbps	8 SO	S8+4	-40°C to +105°C	128
MAX3490AEGSA+	Full	20Mbps	8 SO	S8+4	-40°C to +105°C	128
MAX3491AEASD+	Full	20Mbps	14 SO	S14+1	-40°C to +125°C	128

+Denotes lead(Pb)-free/RoHS-compliant package.

MAX3483AE/MAX3485AE/  
MAX3488AE/MAX3490AE/  
MAX3491AE

+3.3V-Powered,  $\pm 20\text{kV}$  ESD-Protected,  
20Mbps and Slew-Rate-Limited  
RS-485/RS-422 Transceivers

## Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	3/16	Initial release	—
1	9/17	Updated <i>General Description</i> , <i>Functional Diagram</i> , <i>Absolute Maximum Ratings</i> , <i>Electrical Characteristics</i> table, various figures, and <i>Ordering Information</i> table	1–6, 8, 10–12, 15–18

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at [www.maximintegrated.com](http://www.maximintegrated.com).

*Maxim Integrated cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim Integrated product. No circuit patent licenses are implied. Maxim Integrated reserves the right to change the circuitry and specifications without notice at any time. The parametric values (min and max limits) shown in the Electrical Characteristics table are guaranteed. Other parametric values quoted in this data sheet are provided for guidance.*

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Analog Devices Inc.:](#)

[MAX3485AEASA+](#) [MAX3483AEASA+](#) [MAX3485AEASA+T](#) [MAX3488AEGSA+T](#) [MAX3491AEASD+](#)  
[MAX3488AEGSA+](#) [MAX3490AEGSA+T](#) [MAX3483AEASA+T](#) [MAX3490AEGSA+](#) [MAX3491AEASD+T](#)