

**MAX14856/MAX14858****5kV<sub>RMS</sub> Isolated 500kbps/25Mbps Full-Duplex RS-485/RS-422 Transceivers with ±35kV ESD Protection****General Description**

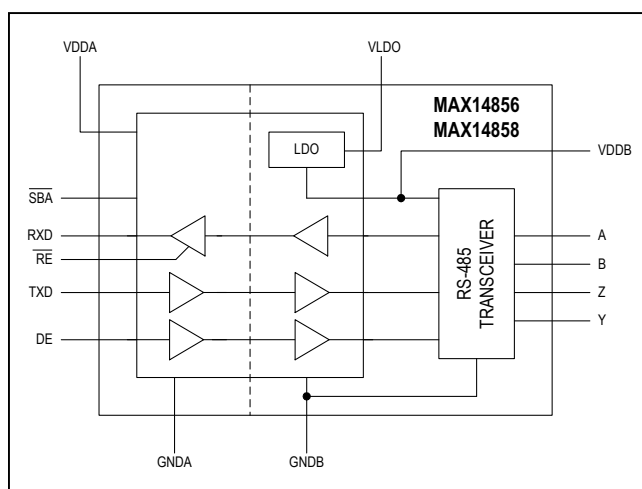
The MAX14856/MAX14858 isolated RS-485/RS-422 transceivers provide 5000V<sub>RMS</sub> (60s) of galvanic isolation between the cable side (RS-485/RS-422 driver/receiver-side) and the UART side of the device. Isolation improves communication by breaking ground loops and reduces noise when there are large differences in ground potential between ports. These devices allow for robust communication up to 500kbps (MAX14856) or 25Mbps (MAX14858).

The devices include one drive channel and one receive channel. The receiver is 1/4-unit load, allowing up to 128 transceivers on a common bus.

Integrated true fail-safe circuitry ensures a logic-high on the receiver output when inputs are shorted or open. Undervoltage lockout disables the driver when the cable side or UART side power supplies are below functional levels.

The driver outputs and receiver inputs are protected from ±35kV electrostatic discharge (ESD) to GNDB on the cable side, as specified by the Human Body Model (HBM).

The devices are available in a wide-body 16-pin SOIC package and operate over the -40°C to +105°C temperature range.

**Functional Diagram****Benefits and Features**

- High-Performance Transceiver Enables Flexible Designs
  - Integrated LDO for Cable Side Power
  - Compliant with RS-485 EIA/TIA-485 Standard
  - 500kbps (MAX14856)/25Mbps (MAX14858) Maximum Data Rate
  - Allows Up to 128 Devices on the Bus
- Integrated Protection Ensures for Robust Communication
  - ±35kV ESD (HBM) on Driver Outputs/Receiver Inputs
  - 5kV<sub>RMS</sub> Withstand Isolation Voltage for 60 Seconds (V<sub>ISO</sub>)
  - 1200V<sub>PEAK</sub> Maximum Repetitive Peak-Isolation Voltage (V<sub>IORM</sub>)
  - 848V<sub>RMS</sub> Maximum Working-Isolation Voltage (V<sub>IOWM</sub>)
  - > 30 Years Lifetime at Rated Working Voltage
  - Withstands ±10kV Surge per IEC 61000-4-5
  - Thermal Shutdown

**Safety Regulatory Approvals**

- UL According to UL1577
- cUL According to CSA Bulletin 5A

**Applications**

- Industrial Automation Equipment
- Programmable Logic Controllers
- HVAC
- Power Meters

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

**Absolute Maximum Ratings**

V <sub>DDA</sub> to G <sub>NDA</sub> .....	-0.3V to +6V	Continuous Power Dissipation (T <sub>A</sub> = +70°C) 16-pin Wide SOIC (derate 14.1mW/°C above +70°C)..... 1126.8mW Operating Temperature Range..... -40°C to +105°C Junction Temperature..... +150°C Storage Temperature Range..... -65°C to +150°C Lead Temperature (soldering, 10s)..... +300°C Soldering Temperature (reflow)..... +260°C
V <sub>DDB</sub> to G <sub>NDB</sub> .....	-0.3V to +6V	
V <sub>LDO</sub> to G <sub>NDB</sub> .....	-0.3V to +16V	
TXD, DE, $\overline{RE}$ to G <sub>NDA</sub> .....	-0.3V to +6V	
$\overline{SBA}$ , RXD to G <sub>NDA</sub> .....	-0.3V to (V <sub>DDA</sub> + 0.3V)	
A, B, Z, Y to G <sub>NDB</sub> .....	-8V to +13V	
Short Circuit Duration (RXD, $\overline{SBA}$ to G <sub>NDA</sub> , A, B, Y, Z, V <sub>DDB</sub> to G <sub>NDB</sub> ) .....	Continuous	

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-Ambient Thermal Resistance (θ <sub>JA</sub> ) .....	71°C/W	Junction-to-Case Thermal Resistance (θ <sub>JC</sub> ).....	23°C/W
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**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).

**DC Electrical Characteristics**

(V<sub>DDA</sub> – V<sub>GNDA</sub> = 1.71V to 5.5V, V<sub>DDB</sub> – V<sub>GNDB</sub> = 3.0V to 5.5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>DDA</sub> – V<sub>GNDA</sub> = 3.3V, V<sub>DDB</sub> – V<sub>GNDB</sub> = 3.3V, V<sub>GNDA</sub> = V<sub>GNDB</sub>, and T<sub>A</sub> = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>POWER</b>						
Supply Voltage	V <sub>DDA</sub>		1.71		5.5	V
	V <sub>DDB</sub>		3.0		5.5	
Supply Current	I <sub>DDA</sub>	V <sub>DDA</sub> = 5V, DE = high, $\overline{RE}$ = TXD = low, RXD unconnected, no load		3.9	6.6	mA
	I <sub>DDB</sub>	DE = high, $\overline{RE}$ = TXD = low, RXD unconnected, no bus load, V <sub>DDB</sub> = 3.3V		7	12.5	
Undervoltage-Lockout Threshold	V <sub>UVLOA</sub>	V <sub>DDA</sub> rising	1.50	1.58	1.65	V
	V <sub>UVLOB</sub>	V <sub>DDB</sub> rising	2.55	2.7	2.85	
Undervoltage-Lockout Threshold Hysteresis	V <sub>UVHYSTA</sub>			50		mV
	V <sub>UVHYSTB</sub>			200		
<b>LDO</b>						
LDO Supply Voltage	V <sub>LDO</sub>	Relative to G <sub>NDB</sub> , LDO is on (Note 4)	3.18		14	V
LDO Supply Current	I <sub>LDO</sub>	DE = high, TXD = low, no bus load, V <sub>LDO</sub> = 5.5V		7.5	12.9	mA
LDO Output Voltage	V <sub>DDB</sub>		3.0	3.3	3.6	V
LDO Current Limit				300		mA
Load Regulation		V <sub>LDO</sub> = 3.3V, I <sub>LOAD</sub> = 20mA to 40mA		0.19	1.7	mV/mA
Line Regulation		V <sub>LDO</sub> = 3.3V to 14V, I <sub>LOAD</sub> = 20mA		0.12	1.8	mV/V
Dropout Voltage		V <sub>LDO</sub> = 3.18V, I <sub>DDB</sub> = -120mA		100	180	mV

## DC Electrical Characteristics (continued)

(V<sub>DDA</sub> – V<sub>GNDA</sub> = 1.71V to 5.5V, V<sub>DDB</sub> – V<sub>GNDB</sub> = 3.0V to 5.5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>DDA</sub> – V<sub>GNDA</sub> = 3.3V, V<sub>DDB</sub> – V<sub>GNDB</sub> = 3.3V, V<sub>GNDA</sub> = V<sub>GNDB</sub>, and T<sub>A</sub> = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Load Capacitance		Nominal value (Note 7)	1		10	μF
<b>LOGIC INTERFACE (TXD, RXD, DE, <math>\overline{RE}</math>, <math>\overline{SBA}</math>)</b>						
Input High Voltage	V <sub>IH</sub>	$\overline{RE}$ , TXD, DE to G <sub>NDA</sub>	2.25V ≤ V <sub>DDA</sub> ≤ 5.5V	0.7 x V <sub>DDA</sub>		V
			1.71V ≤ V <sub>DDA</sub> ≤ 1.89V	0.78 x V <sub>DDA</sub>		
Input Low Voltage	V <sub>IL</sub>	$\overline{RE}$ , TXD, DE to G <sub>NDA</sub>	2.25V ≤ V <sub>DDA</sub> ≤ 5.5V	0.8		V
			1.71V ≤ V <sub>DDA</sub> ≤ 1.89V	0.6		
Input Hysteresis	V <sub>HYS</sub>	$\overline{RE}$ , TXD, DE to G <sub>NDA</sub>		220		mV
Input Capacitance	C <sub>IN</sub>	$\overline{RE}$ , TXD, DE, f = 1MHz		2		pF
Input Pullup Current	I <sub>PU</sub>	TXD	-10	-4.5	-1.5	μA
Input Pulldown Current	I <sub>PD</sub>	DE, $\overline{RE}$	1.5	4.5	10	μA
$\overline{SBA}$ Pullup Resistance	R <sub>SBA</sub>		3	5	8	kΩ
Output Voltage High	V <sub>OH</sub>	RXD to G <sub>NDA</sub> , I <sub>OUT</sub> = -4mA	V <sub>DDA</sub> -0.4			V
Output Voltage Low	V <sub>OL</sub>	RXD to G <sub>NDA</sub> , I <sub>OUT</sub> = 4mA			0.40	V
		$\overline{SBA}$ to G <sub>NDA</sub> , I <sub>OUT</sub> = 4mA			0.45	
Short-Circuit Output Pullup Current	I <sub>SH_PU</sub>	0V ≤ V <sub>RXD</sub> ≤ V <sub>DDA</sub> , (V <sub>A</sub> - V <sub>B</sub> ) > -10mV, $\overline{RE}$ = low	-42			mA
Short-Circuit Output Pulldown Current	I <sub>SH_PD</sub>	0V ≤ V <sub>RXD</sub> ≤ V <sub>DDA</sub> , (V <sub>A</sub> - V <sub>B</sub> ) < -200mV, $\overline{RE}$ = low			40	mA
		0V ≤ V <sub><math>\overline{SBA}</math></sub> ≤ V <sub>DDA</sub> , side B is powered and working			60	
Three-State Output Current	I <sub>OZ</sub>	0V ≤ V <sub>RXD</sub> ≤ V <sub>DDA</sub> , $\overline{RE}$ = high	-1		+1	μA
<b>DRIVER</b>						
Differential Driver Output	V <sub>OD</sub>	R <sub>L</sub> = 54Ω, TXD = high or low, Figure 1a	1.5			V
		R <sub>L</sub> = 100Ω, TXD = high or low, Figure 1a	2.0			
		-7V ≤ V <sub>CM</sub> ≤ +12V, Figure 1b	1.5		5	
Change in Magnitude of Differential Driver Output Voltage	ΔV <sub>OD</sub>	R <sub>L</sub> = 100Ω or 54Ω, Figure 1a (Note 5)			0.2	V
Driver Common Mode Output Voltage	V <sub>OC</sub>	R <sub>L</sub> = 100Ω or 54Ω, Figure 1a (Note 5)	V <sub>DDB</sub> /2		3	V
Change in Magnitude of Common-Mode Voltage	ΔV <sub>OC</sub>	R <sub>L</sub> = 100Ω or 54Ω, Figure 1a (Note 5)			0.2	V

**DC Electrical Characteristics (continued)**

(V<sub>DDA</sub> – V<sub>GNDA</sub> = 1.71V to 5.5V, V<sub>DDB</sub> – V<sub>GNDB</sub> = 3.0V to 5.5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>DDA</sub> – V<sub>GNDA</sub> = 3.3V, V<sub>DDB</sub> – V<sub>GNDB</sub> = 3.3V, V<sub>GNDA</sub> = V<sub>GNDB</sub>, and T<sub>A</sub> = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Driver Short-Circuit Output Current	I <sub>OSD</sub>	GNDB ≤ V <sub>OUT</sub> ≤ +12V, output low (Note 6)	+30		+250	mA
		-7V ≤ V <sub>OUT</sub> ≤ V <sub>DDB</sub> , output high (Note 6)	-250		-30	
Single-Ended Driver Output Voltage High	V <sub>OH</sub>	Y and Z outputs, I <sub>Y,Z</sub> = -20mA	2.2			V
Single-Ended Driver Output Voltage Low	V <sub>OL</sub>	Y and Z outputs, I <sub>Y,Z</sub> = +20mA			0.8	V
Differential Driver Output Capacitance	C <sub>OD</sub>	DE = $\overline{RE}$ = high, f = 4MHz		12		pF
<b>RECEIVER</b>						
Input Current (A and B)	I <sub>A</sub> , I <sub>B</sub>	DE = low, V <sub>DDB</sub> = GNDB or 3.6V	V <sub>IN</sub> = +12V		+250	μA
			V <sub>IN</sub> = -7V	-200		
Receiver Differential Threshold Voltage	V <sub>TH</sub>	-7V ≤ V <sub>CM</sub> ≤ +12V	-200	-120	-10	mV
Receiver Input Hysteresis	ΔV <sub>TH</sub>	V <sub>CM</sub> = 0V		20		mV
Receiver Input Resistance	R <sub>IN</sub>	-7V ≤ V <sub>CM</sub> ≤ +12V, DE = low	48			kΩ
Differential Input Capacitance	C <sub>A,B</sub>	Measured between A and B, DE = $\overline{RE}$ = low at 6MHz		12		pF
<b>PROTECTION</b>						
Thermal-Shutdown Threshold	T <sub>SHDN</sub>	Temperature Rising		+160		°C
Thermal-Shutdown Hysteresis	T <sub>HYST</sub>			15		°C
ESD Protection (A and B Pins to GNDB)		Human Body Model		±35		kV
		IEC 61000-4-2 Air Gap Discharge		±18		
		IEC 61000-4-2 Contact Discharge		±8		
ESD Protection (All Other Pins)		Human Body Model		±4		kV

**Switching Electrical Characteristics (MAX14856)**

(V<sub>DDA</sub> – V<sub>GNDA</sub> = 1.71V to 5.5V, V<sub>DDB</sub> – V<sub>GNDB</sub> = 3.0V to 5.5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>DDA</sub> – V<sub>GNDA</sub> = 3.3V, V<sub>DDB</sub> – V<sub>GNDB</sub> = 3.3V, V<sub>GNDA</sub> = V<sub>GNDB</sub>, and T<sub>A</sub> = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DYNAMIC</b>						
Common Mode Transient Immunity	CMTI	(Note 8)		35		kV/μs
Glitch Rejection		TXD, DE, RXD	10	17	29	ns
<b>DRIVER</b>						
Driver Propagation Delay	t <sub>DPLH</sub> , t <sub>DPHL</sub>	R <sub>L</sub> = 54Ω, C <sub>L</sub> = 50pF, Figure 2 and Figure 3			1040	ns
Differential Driver Output Skew  t <sub>DPLH</sub> - t <sub>DPHL</sub>	t <sub>DSKEW</sub>	R <sub>L</sub> = 54Ω, C <sub>L</sub> = 50pF, Figure 2 and Figure 3			144	ns
Driver Differential Output Rise or Fall Time	t <sub>LH</sub> , t <sub>HL</sub>	R <sub>L</sub> = 54Ω, C <sub>L</sub> = 50pF, Figure 2 and Figure 3			900	ns
Maximum Data Rate	DR <sub>MAX</sub>		500			kbps
Driver Enable to Output High	t <sub>DZH</sub>	R <sub>L</sub> = 110Ω, C <sub>L</sub> = 50pF, Figure 5			2540	ns
Driver Enable to Output Low	t <sub>DZL</sub>	R <sub>L</sub> = 110Ω, C <sub>L</sub> = 50pF, Figure 5			2540	ns
Driver Disable Time from Low	t <sub>DLZ</sub>	R <sub>L</sub> = 110Ω, C <sub>L</sub> = 50pF, Figure 5			140	ns
Driver Disable Time from High	t <sub>DHZ</sub>	R <sub>L</sub> = 110Ω, C <sub>L</sub> = 50pF, Figure 4			140	ns
<b>RECEIVER</b>						
Receiver Propagation Delay	t <sub>RPLH</sub> , t <sub>RPHL</sub>	C <sub>L</sub> = 15pF, Figure 6 and Figure 7 (Note 9)			240	ns
Receiver Output Skew  t <sub>RPLH</sub> - t <sub>RPHL</sub>	t <sub>RSKEW</sub>	C <sub>L</sub> = 15pF, Figure 6 and Figure 7 (Note 9)			34	ns
Maximum Data Rate	DR <sub>MAX</sub>		500			kbps
Receiver Enable to Output High	t <sub>RZH</sub>	R <sub>L</sub> = 1kΩ, C <sub>L</sub> = 15pF, S2 closed, Figure 8			20	ns
Receiver Enable to Output Low	t <sub>RZL</sub>	R <sub>L</sub> = 1kΩ, C <sub>L</sub> = 15pF, S1 closed, Figure 8			30	ns
Receiver Disable Time From Low	t <sub>RLZ</sub>	R <sub>L</sub> = 1kΩ, C <sub>L</sub> = 15pF, S1 closed, Figure 8			20	ns
Receiver Disable Time From High	t <sub>RHZ</sub>	R <sub>L</sub> = 1kΩ, C <sub>L</sub> = 15pF, S2 closed, Figure 8			20	ns

**Switching Electrical Characteristics (MAX14858)**

(V<sub>DDA</sub> – V<sub>GNDA</sub> = 1.71V to 5.5V, V<sub>DDB</sub> – V<sub>GNDB</sub> = 3.0V to 5.5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>DDA</sub> – V<sub>GNDA</sub> = 3.3V, V<sub>DDB</sub> – V<sub>GNDB</sub> = 3.3V, V<sub>GNDA</sub> = V<sub>GNDB</sub>, and T<sub>A</sub> = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DYNAMIC</b>						
Common Mode Transient Immunity	CMTI	(Note 8)		35		kV/μs
Glitch Rejection		TXD, DE, RXD	10	17	29	ns
<b>DRIVER</b>						
Driver Propagation Delay	t <sub>DPLH</sub> , t <sub>DPHL</sub>	R <sub>L</sub> = 54Ω, C <sub>L</sub> = 50pF, Figure 2 and Figure 3			65	ns
Differential Driver Output Skew  t <sub>DPLH</sub> - t <sub>DPHL</sub>	t <sub>DSKEW</sub>	R <sub>L</sub> = 54Ω, C <sub>L</sub> = 50pF, Figure 2 and Figure 3			7	ns
Driver Differential Output Rise or Fall Time	t <sub>LH</sub> , t <sub>HL</sub>	R <sub>L</sub> = 54Ω, C <sub>L</sub> = 50pF, Figure 2 and Figure 3			10	ns
Maximum Data Rate	DR <sub>MAX</sub>		25			Mbps
Driver Enable to Output High	t <sub>DZH</sub>	R <sub>L</sub> = 110Ω, C <sub>L</sub> = 50pF, Figure 4			80	ns
Driver Enable to Output Low	t <sub>DZL</sub>	R <sub>L</sub> = 110Ω, C <sub>L</sub> = 50pF, Figure 5			80	ns
Driver Disable Time from Low	t <sub>DLZ</sub>	R <sub>L</sub> = 110Ω, C <sub>L</sub> = 50pF, Figure 5			80	ns
Driver Disable Time from High	t <sub>DHZ</sub>	R <sub>L</sub> = 110Ω, C <sub>L</sub> = 50pF, Figure 4			80	ns
<b>RECEIVER</b>						
Receiver Propagation Delay	t <sub>RPLH</sub> , t <sub>RPHL</sub>	C <sub>L</sub> = 15pF, Figure 6 and Figure 7 (Note 9)			65	ns
Receiver Output Skew  t <sub>RPLH</sub> - t <sub>RPHL</sub>	t <sub>RSKEW</sub>	C <sub>L</sub> = 15pF, Figure 6 and Figure 7 (Note 9)			7	ns
Maximum Data Rate	DR <sub>MAX</sub>		25			Mbps
Receiver Enable to Output High	t <sub>RZH</sub>	R <sub>L</sub> = 1kΩ, C <sub>L</sub> = 15pF, S2 closed, Figure 8			20	ns
Receiver Enable to Output Low	t <sub>RZL</sub>	R <sub>L</sub> = 1kΩ, C <sub>L</sub> = 15pF, S1 closed, Figure 8			30	ns
Receiver Disable Time From Low	t <sub>RLZ</sub>	R <sub>L</sub> = 1kΩ, C <sub>L</sub> = 15pF, S1 closed, Figure 8			20	ns
Receiver Disable Time From High	t <sub>RHZ</sub>	R <sub>L</sub> = 1kΩ, C <sub>L</sub> = 15pF, S2 closed, Figure 8			20	ns

**Note 2:** All devices are 100% production tested at T<sub>A</sub> = +25°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 their respective ground (GNDA or GNDB), unless otherwise noted.

**Note 4:** V<sub>LDO</sub> max indicates voltage capability of the circuit. Power dissipation requirements may limit V<sub>LDO</sub> max to a lower value.

**Note 5:** ΔV<sub>OD</sub> and ΔV<sub>OC</sub> are the changes in V<sub>OD</sub> and V<sub>OC</sub>, respectively, when the TXD input changes state.

**Note 6:** The short circuit output current applies to the peak current just prior to current limiting.

**Note 7:** Not production tested. Guaranteed by design.

**Note 8:** CMTI is the maximum sustainable common-mode voltage slew rate while maintaining the correct output states. CMTI applies to both rising and falling common-mode voltage edges. Tested with the transient generator connected between GNDA and GNDB. V<sub>CM</sub> = 1kV

**Note 9:** Capacitive load includes test probe and fixture capacitance.

## Insulation Characteristics

PARAMETER	SYMBOL	CONDITIONS	VALUE	UNITS
Partial Discharge Test Voltage	V <sub>PR</sub>	Method B1 = V <sub>IORM</sub> × 1.875 (t = 1s, partial discharge < 5pC)	2250	V <sub>P</sub>
Maximum Repetitive Peak Withstand Voltage	V <sub>IORM</sub>	(Note 7)	1200	V <sub>P</sub>
Maximum Working Isolation Voltage	V <sub>IOWM</sub>	(Note 7)	848	V <sub>RMS</sub>
Maximum Transient Isolation Voltage	V <sub>IOTM</sub>	t = 1s	8400	V <sub>P</sub>
Maximum Withstand Isolation Voltage	V <sub>ISO</sub>	t = 60s, f = 60Hz (Note 7, 8)	5000	V <sub>RMS</sub>
Maximum surge Isolation Voltage	V <sub>IOSM</sub>	IEC 61000-4-5, 1.2/50μs	10	kV
Insulation Resistance	R <sub>S</sub>	T <sub>A</sub> = +150°C, V <sub>IO</sub> = 500V	>10 <sup>9</sup>	Ω
Barrier Capacitance Input to Output	C <sub>IO</sub>		2	pF
Creepage Distance	CPG	Wide SO	8	mm
Clearance Distance	CLR	Wide SO	8	mm
Internal Clearance		Distance through insulation	0.015	mm
Comparitive Tracking Resistance Index	CTI	Material Group II (IEC 60112)	575	
Climatic Category			40/125/21	
Pollution Degree (DIN VDE 0110, Table 1)			2	

**Note 10:** V<sub>IORM</sub>, V<sub>IOWM</sub>, and V<sub>ISO</sub> are defined by the IEC 60747-5-5 standard.

**Note 11:** Product is qualified at V<sub>ISO</sub> for 60 seconds. 100% production tested at 120% of V<sub>ISO</sub> for 1 second.

## Safety Regulatory Approvals

<b>UL</b>
The MAX14856/MAX14858 is certified under UL1577. For more details, see File E351759.
Rate up to 5000V <sub>RMS</sub> isolation voltage for basic insulation.
<b>cUL</b>
The MAX14856/MAX14858 is certified under UL1577. For more details, see File E351759. Rate up to 5000V <sub>RMS</sub> isolation voltage for basic insulation.

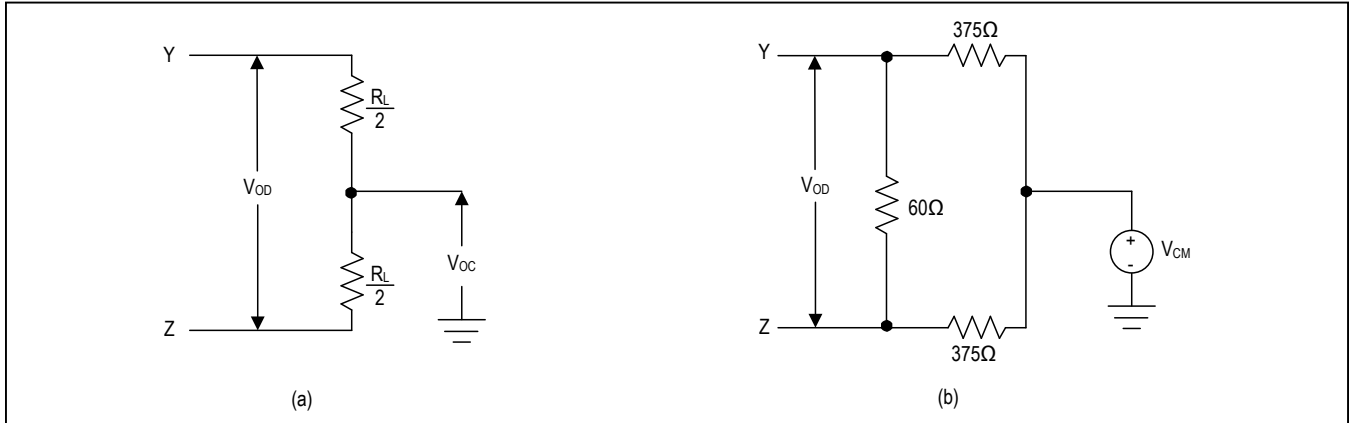


Figure 1. Driver DC Test Load

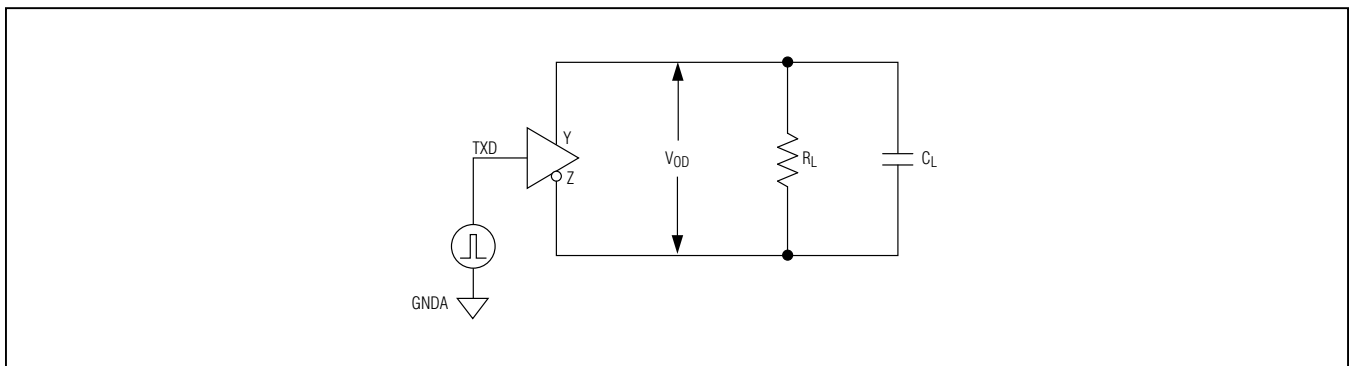


Figure 2. Driver Timing Test Circuit

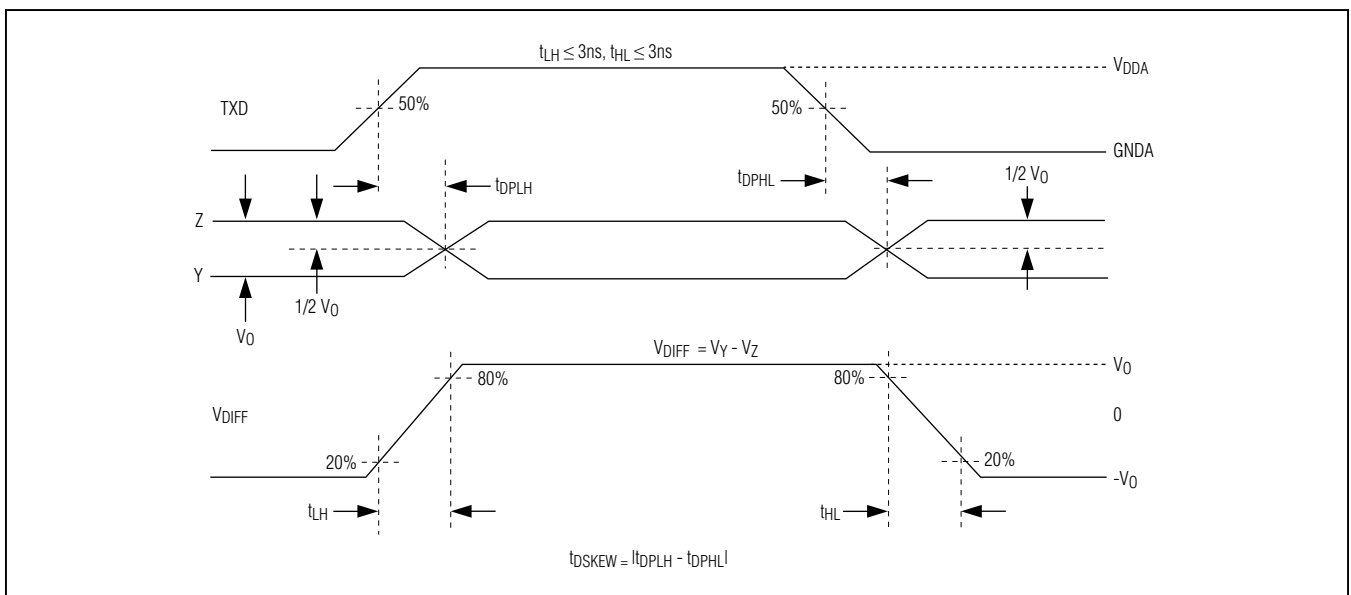


Figure 3. Driver Propagation Delays



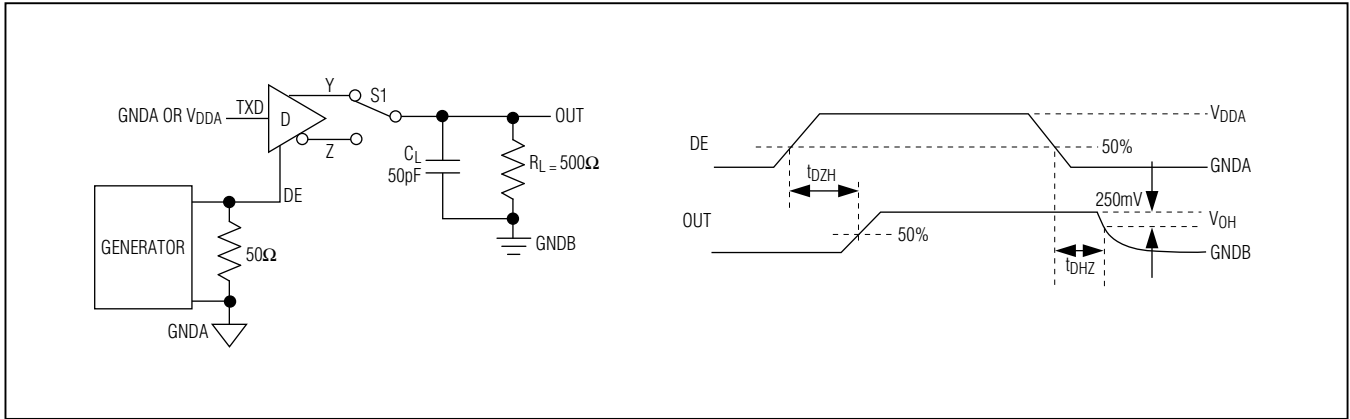


Figure 4. Driver Enable and Disable Times ( $t_{DZH}$ ,  $t_{DHZ}$ )



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

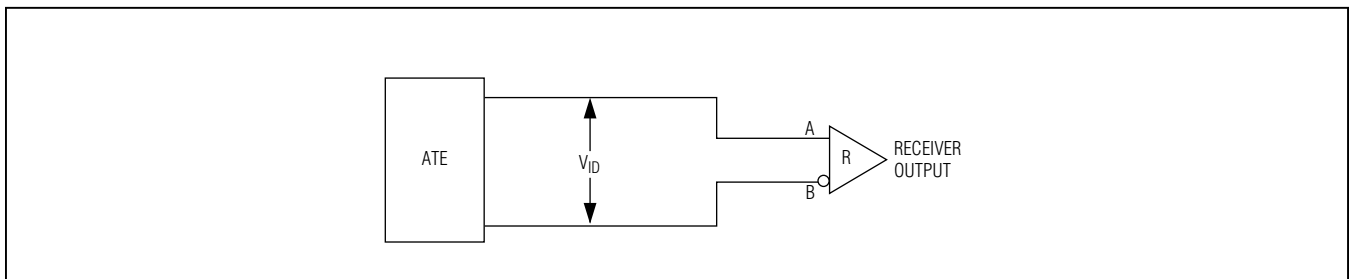


Figure 6. Receiver Propagation Delay Test Circuit

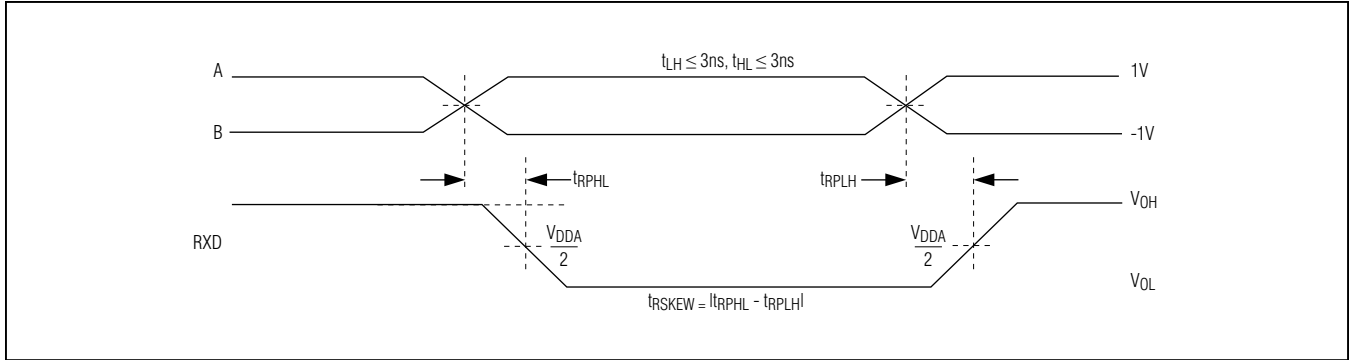


Figure 7. Receiver Propagation Delays

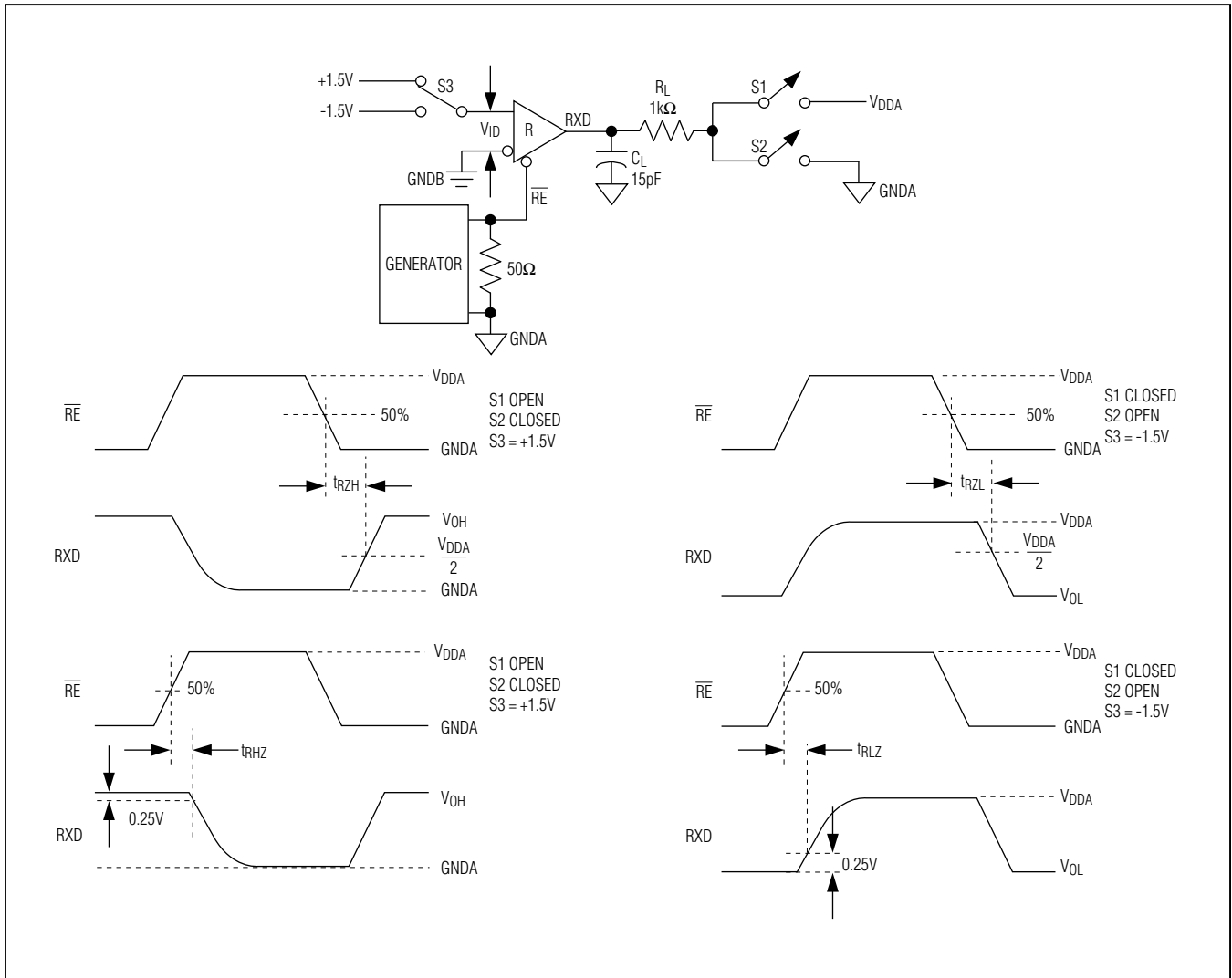
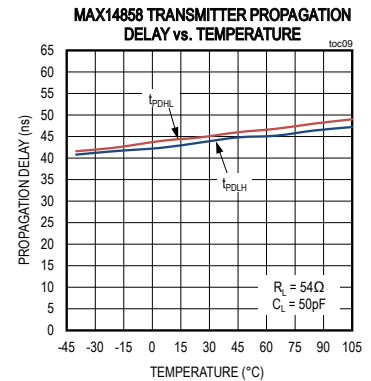
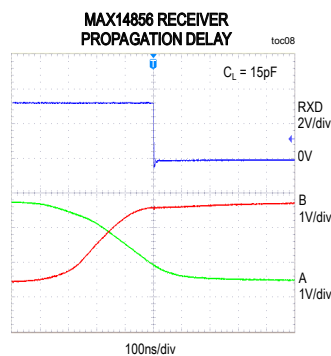
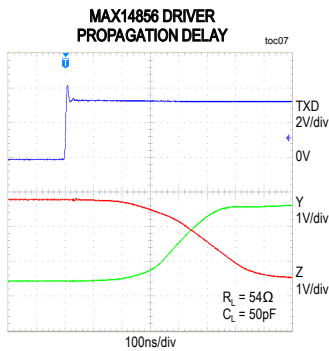
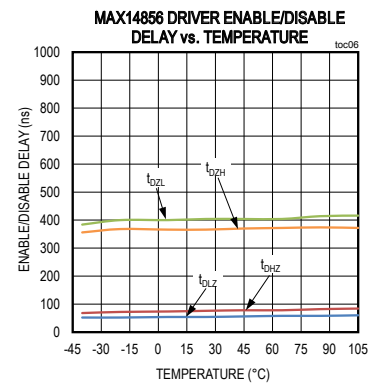
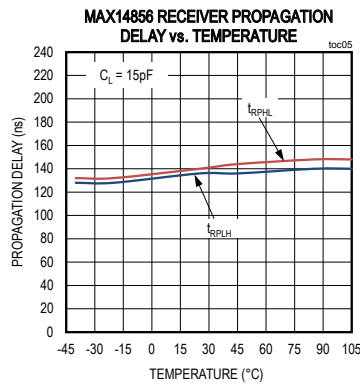
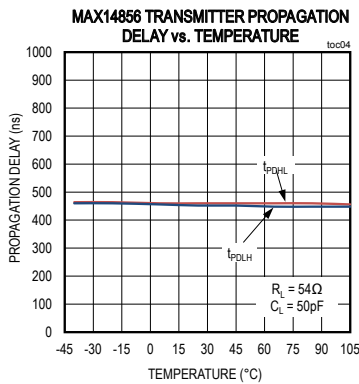
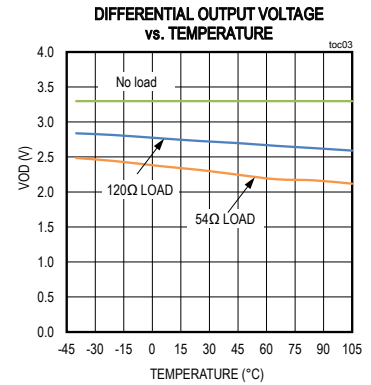
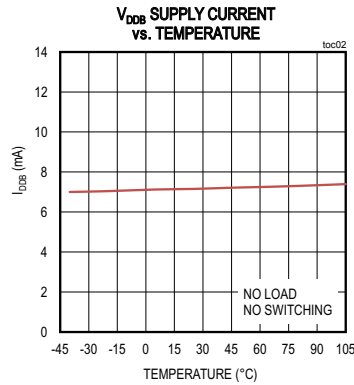
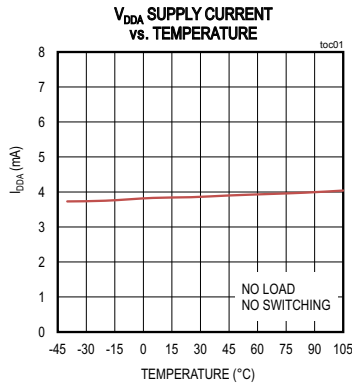


Figure 8. Receiver Enable and Disable Times

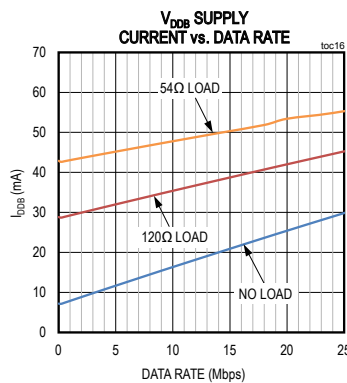
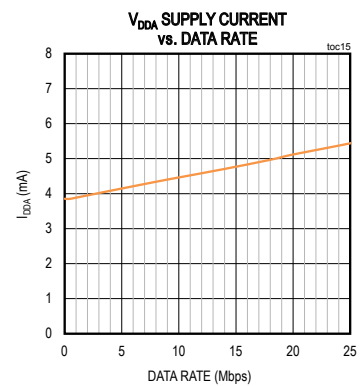
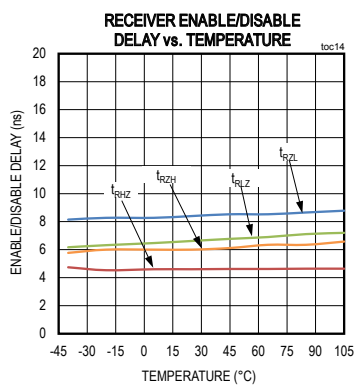
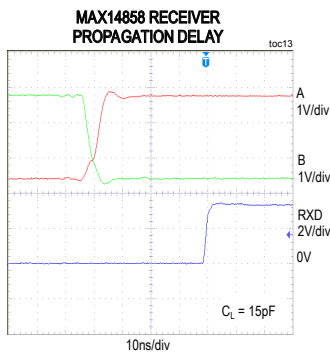
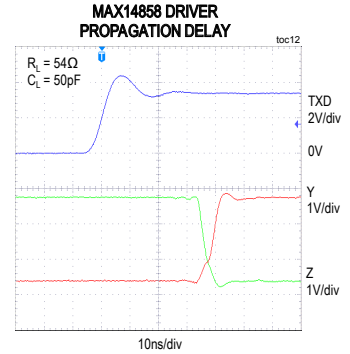
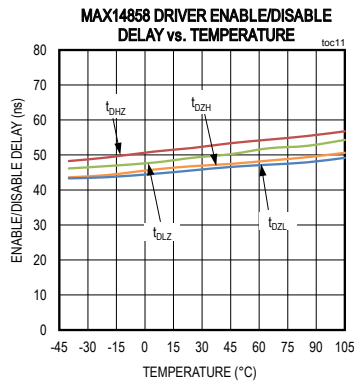
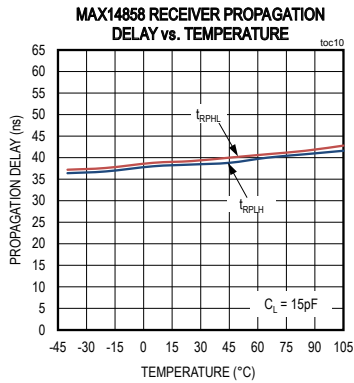
Typical Operating Characteristics

(V<sub>DDA</sub> - V<sub>GNDA</sub> = 3.3V, V<sub>DDB</sub> - V<sub>GNDB</sub> = 3.3V, V<sub>GNDA</sub> = V<sub>GNDB</sub>, and T<sub>A</sub> = +25°C, unless otherwise noted.)

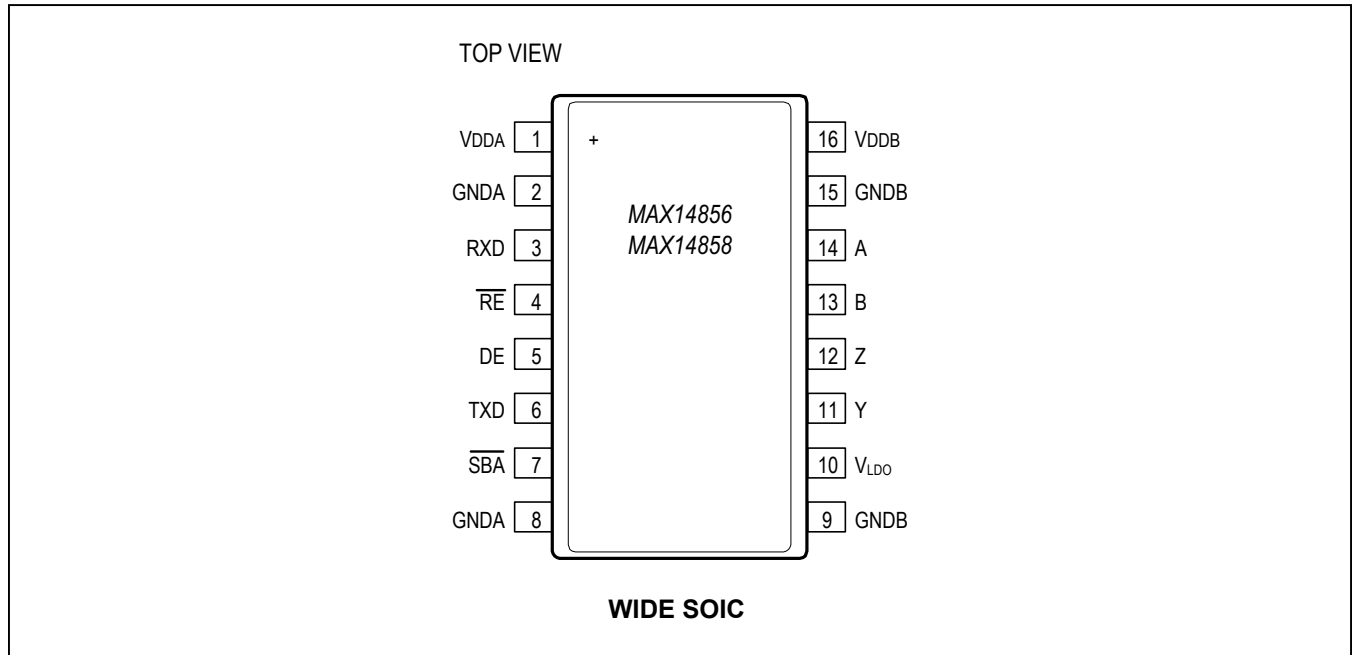


Typical Operating Characteristics (continued)

(V<sub>DDA</sub> - V<sub>GNDA</sub> = 3.3V, V<sub>DDB</sub> - V<sub>GNDB</sub> = 3.3V, V<sub>GNDA</sub> = V<sub>GNDB</sub>, and T<sub>A</sub> = +25°C, unless otherwise noted.)



Pin Configuration



Pin Description

PIN	NAME	REFERENCE	FUNCTION
1	V <sub>DDA</sub>	GNDA	UART/Logic-Side Power Input. Bypass V <sub>DDA</sub> to GNDA with both 0.1µF and 1µF capacitors as close to the device as possible.
2, 8	GNDA	-	UART/Logic-Side Ground. GNDA is the ground reference for digital signals.
3	RXD	GNDA	Receiver Data Output. Drive $\overline{RE}$ low to enable RXD. With $\overline{RE}$ low, RXD is high when $(V_A - V_B) > -10mV$ and is low when $(V_A - V_B) < -200mV$ . RXD is high when V <sub>DDB</sub> is less than V <sub>UVLOB</sub> . RXD is high impedance when $\overline{RE}$ is high.
4	$\overline{RE}$	GNDA	Receiver Output Enable. Drive $\overline{RE}$ low or connect to GNDA to enable RXD. Drive $\overline{RE}$ high to disable RXD. RXD is high-impedance when $\overline{RE}$ is high. $\overline{RE}$ has an internal 4.5µA pull-down to GNDA.
5	DE	GNDA	Driver Output Enable. Drive DE high to enable bus driver outputs Y and Z. Drive DE low or connect to GNDA to disable Y and Z. Y and Z are high impedance when DE is low. DE has an internal 4.5µA pull-down to GNDA.
6	TXD	GNDA	Driver Input. With DE high, a low on TXD forces the noninverting output (Y) low and the inverting output (Z) high. Similarly, a high on TXD forces the noninverting output high and the inverting output low. TXD has an internal 4.5µA pullup to V <sub>DDA</sub> .
7	$\overline{SBA}$	GNDA	Side B Active Indicator Output. $\overline{SBA}$ asserts low when side B is powered and working. $\overline{SBA}$ has an internal 5kΩ pull-up resistor to V <sub>DDA</sub> .

## Pin Description (continued)

PIN	NAME	REFERENCE	FUNCTION
9, 15	GNDB	-	Cable Side Ground. GNDB is the ground reference for the internal LDO and the RS-485/RS-422 bus signals.
10	VLDO	GNDB	LDO Power Input. Connect a minimum voltage of 3.18V to VLDO to power the cable side of the transceiver. Bypass VLDO to GNDB with both 0.1µF and 1µF capacitors as close to the device as possible. To disable the internal LDO, leave VLDO unconnected or connect to GNDB.
11	Y	GNDB	Noninverting Driver Output
12	Z	GNDB	Inverting Driver Output
13	B	GNDB	Inverting Receiver Input
14	A	GNDB	Noninverting Receiver Input
16	VDDB	GNDB	Cable Side Power Input/Isolated LDO Power Output. Bypass VDDB to GNDB with both 0.1µF and 1µF capacitor as close to the device as possible. VDDB is the output of the internal LDO when power is applied to VLDO. When the internal LDO is not used (VLDO is unconnected or connected to GNDB), VDDB is the positive supply input for the cable side of the IC.

## Function Tables

TRANSMITTING					
INPUTS				OUTPUTS	
V <sub>DDA</sub>	V <sub>DDB</sub>	DE	TXD	Y	Z
≥ V <sub>UVLOA</sub>	≥ V <sub>UVLOB</sub>	1	1	1	0
≥ V <sub>UVLOA</sub>	≥ V <sub>UVLOB</sub>	1	0	0	1
≥ V <sub>UVLOA</sub>	≥ V <sub>UVLOB</sub>	0	X	High-Z	High-Z
< V <sub>UVLOA</sub>	≥ V <sub>UVLOB</sub>	X	X	High-Z	High-Z
≥ V <sub>UVLOA</sub>	< V <sub>UVLOB</sub>	X	X	High-Z	High-Z
< V <sub>UVLOA</sub>	< V <sub>UVLOB</sub>	X	X	High-Z	High-Z

\*Note: Drive DE low to disable the transmitter outputs. Drive DE high to enable the transmitter outputs. DE has an internal pulldown to GNDA.

X = Don't care

RECEIVING				
INPUTS				OUTPUTS
V <sub>DDA</sub>	V <sub>DDB</sub>	$\overline{RE}$	(V <sub>A</sub> - V <sub>B</sub> )	RXD
≥ V <sub>UVLOA</sub>	≥ V <sub>UVLOB</sub>	0	> -10mV	1
≥ V <sub>UVLOA</sub>	≥ V <sub>UVLOB</sub>	0	< -200mV	0
≥ V <sub>UVLOA</sub>	≥ V <sub>UVLOB</sub>	0	Open/Short	1
≥ V <sub>UVLOA</sub>	≥ V <sub>UVLOB</sub>	1	X	High-Z
< V <sub>UVLOA</sub>	≥ V <sub>UVLOB</sub>	X	X	High-Z
≥ V <sub>UVLOA</sub>	< V <sub>UVLOB</sub>	0	X	1
< V <sub>UVLOA</sub>	< V <sub>UVLOB</sub>	X	X	High-Z

\*Note: Drive  $\overline{RE}$  high to disable the receiver output. Drive  $\overline{RE}$  low to enable to receiver output.  $\overline{RE}$  has an internal pulldown to GNDA.

X = Don't care

$\overline{SBA}$		
V <sub>DDA</sub>	V <sub>DDB</sub>	$\overline{SBA}$
< V <sub>UVLOA</sub>	< V <sub>UVLOB</sub>	High
< V <sub>UVLOA</sub>	≥ V <sub>UVLOB</sub>	High
≥ V <sub>UVLOA</sub>	< V <sub>UVLOB</sub>	High
≥ V <sub>UVLOA</sub>	≥ V <sub>UVLOB</sub>	Low

## Detailed Description

The MAX14856/MAX14858 isolated RS-485/RS-422 transceivers provide 5000V<sub>RMS</sub> (60s) of galvanic isolation between the RS-485/RS-422 cable side of the transceiver and the UART side. These devices allow up to 500kbps (MAX14856)/25Mbps (MAX14858) communication across an isolation barrier when a large potential exists between grounds on each side of the barrier.

### Isolation

Data isolation is achieved using high-voltage capacitors that allow data transmission between the UART side and the RS-485/RS-422 cable side of the transceiver.

### Integrated LDO

The devices include an internal low-dropout regulator with a set 3.3V (typ) output that is used to power the cable-side of the IC. The output of the LDO is V<sub>DDB</sub>. The LDO has a 300mA (typ) current limit. If the LDO is unused, connect V<sub>LDO</sub> to GNDB and apply +3.3V directly to V<sub>DDB</sub>.

### True Fail-Safe

The devices guarantee a logic-high on the receiver output when the receiver inputs are shorted or open, or when connected to a terminated transmission line with all drivers disabled. The receiver threshold is fixed between -10mV and -200mV. If the differential receiver input voltage (V<sub>A</sub> – V<sub>B</sub>) is greater than or equal to -10mV, RXD is logic-high. In the case of a terminated bus with all transmitters disabled, the receiver's differential input voltage is pulled to zero by the termination resistors. Due to the receiver thresholds of the devices, this results in a logic-high at RXD.

### Driver Output Protection

Two mechanisms prevent excessive output current and power dissipation caused by faults or bus contention. The first, a current limit on the output stage, provides immediate protection against short circuits over the entire 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°C (typ).

### Thermal Shutdown

The devices are protected from overtemperature damage by integrated thermal shutdown circuitry. When the junction temperature (T<sub>J</sub>) exceeds +160°C (typ), the driver outputs go high-impedance. The device resumes normal operation when T<sub>J</sub> falls below +145°C (typ).

## Applications Information

### 128 Transceivers on the Bus

The standard RS-485 receiver input impedance is one unit load. A standard driver can drive up to 32 unit-loads. The devices' transceivers have a 1/4-unit load receiver, which allows up to 128 transceivers, connected in parallel, on one communication line. Connect any combination of these devices, and/or other RS-485 devices, for a maximum of 32 unit-loads to the line.

### Typical Application

The MAX14856/MAX14858 full-duplex transceivers are designed for bidirectional data communications on multi-point bus transmission lines. [Figure 9](#) and [Figure 10](#) show typical network application circuits. To minimize reflections, the bus should be terminated at both ends in its characteristics impedance, and stub lengths off the main line should be kept as short as possible.



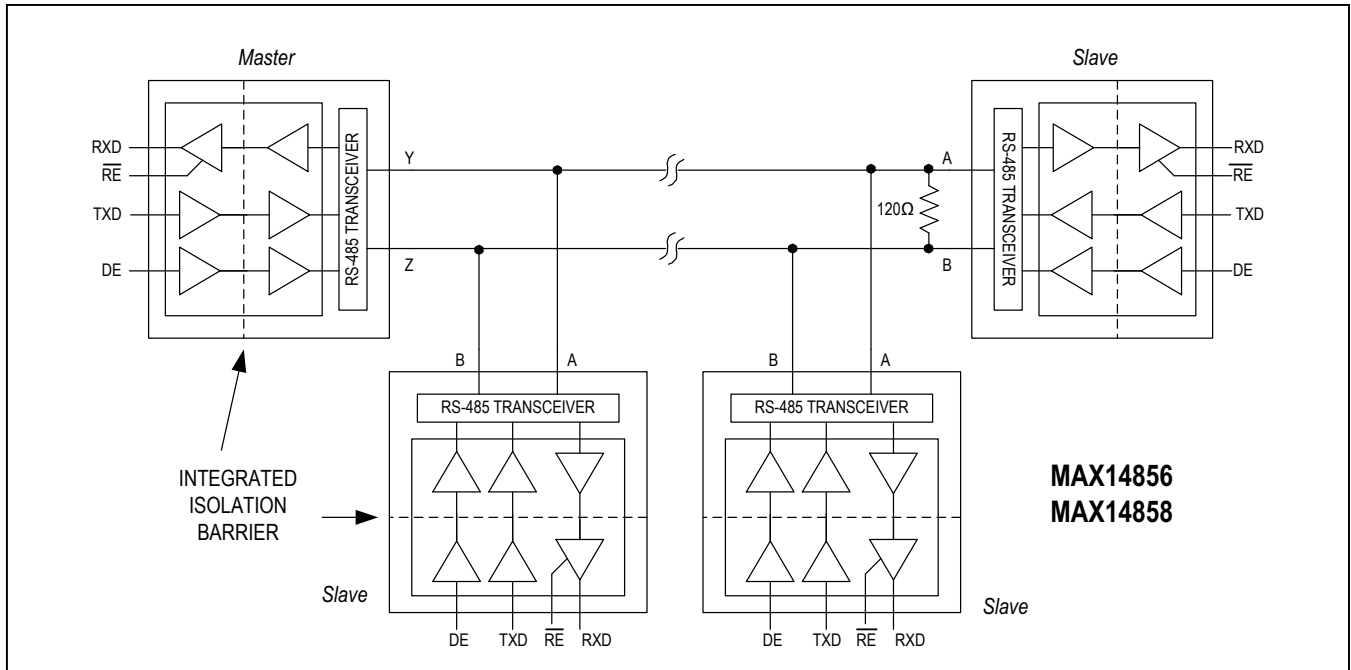


Figure 9. Typical Isolated Full-Duplex RS-485/RS-422 Application

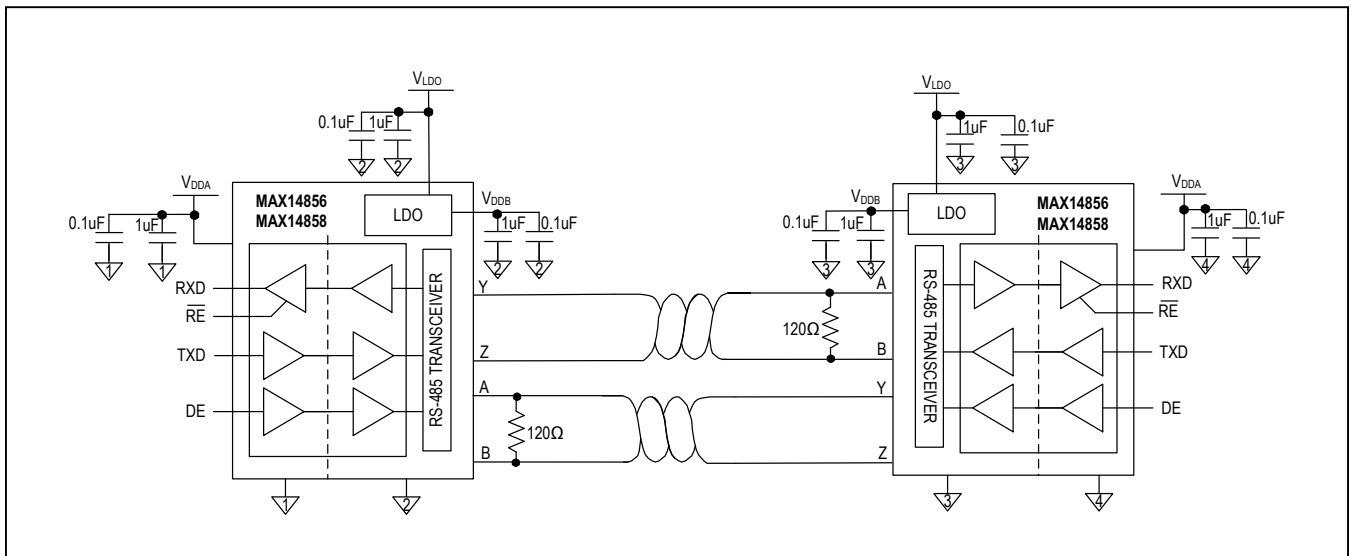


Figure 10. Typical Isolated Point-to-Point Application

### Layout Considerations

It is recommended to design an isolation, or “keep-out,” channel underneath the isolator that is free from ground and signal planes. Any galvanic or metallic connection between the cable side and UART side will defeat the isolation.

Ensure that the decoupling capacitors between V<sub>DDA</sub> and G<sub>NDA</sub> and between V<sub>LDO</sub>, V<sub>DDB</sub>, and G<sub>NDB</sub> are located as close as possible to the IC to minimize inductance.

Route important signal lines close to the ground plane to minimize possible external influences. On the cable side of the devices, it is good practice to have the bus connectors and termination resistor as close as possible to the A and B pins.

### Extended ESD Protection

ESD protection structures are incorporated on all pins to protect against electrostatic discharge encountered during handling and assembly. The driver outputs and receiver inputs of the MAX14856/MAX14858 have extra protection against static electricity to both the UART side and cable side ground references. The ESD structures withstand high-ESD events during normal operation and when powered down. After an ESD event, the devices keep working without latch-up or damage.

Bypass V<sub>DDA</sub> to G<sub>NDA</sub> and bypass V<sub>DDB</sub> and V<sub>LDO</sub> to G<sub>NDB</sub> with 0.1µF and 1µF capacitors to ensure maximum ESD protection.

ESD protection can be tested in various ways. The transmitter outputs and receiver inputs of the MAX14856/MAX14858 are characterized for protection to the cable side ground (G<sub>NDB</sub>) to the following limits:

- ±35kV HBM
- ±18kV 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 11](#) shows the HBM test model, while [Figure 12](#) shows the current waveform it generates when discharged in 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 MAX14856/MAX14858 help 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 13](#) shows the IEC 61000-4-2 model and [Figure 14](#) shows the current waveform for IEC 61000-4-2 ESD Contact Discharge Test.

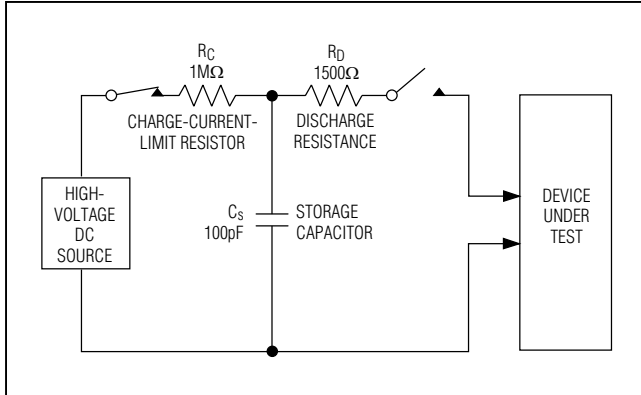


Figure 11. Human Body ESD Test Model

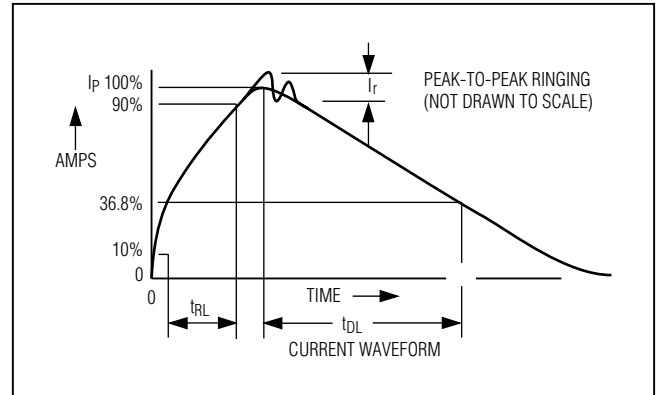


Figure 12. Human Body Current Waveform

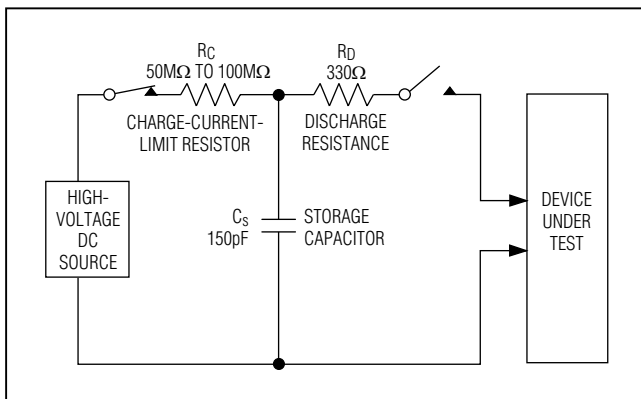


Figure 13. IEC 61000-4-2 ESD Test Model

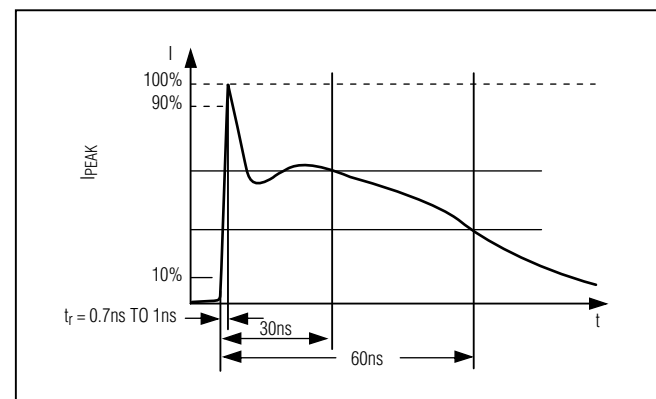
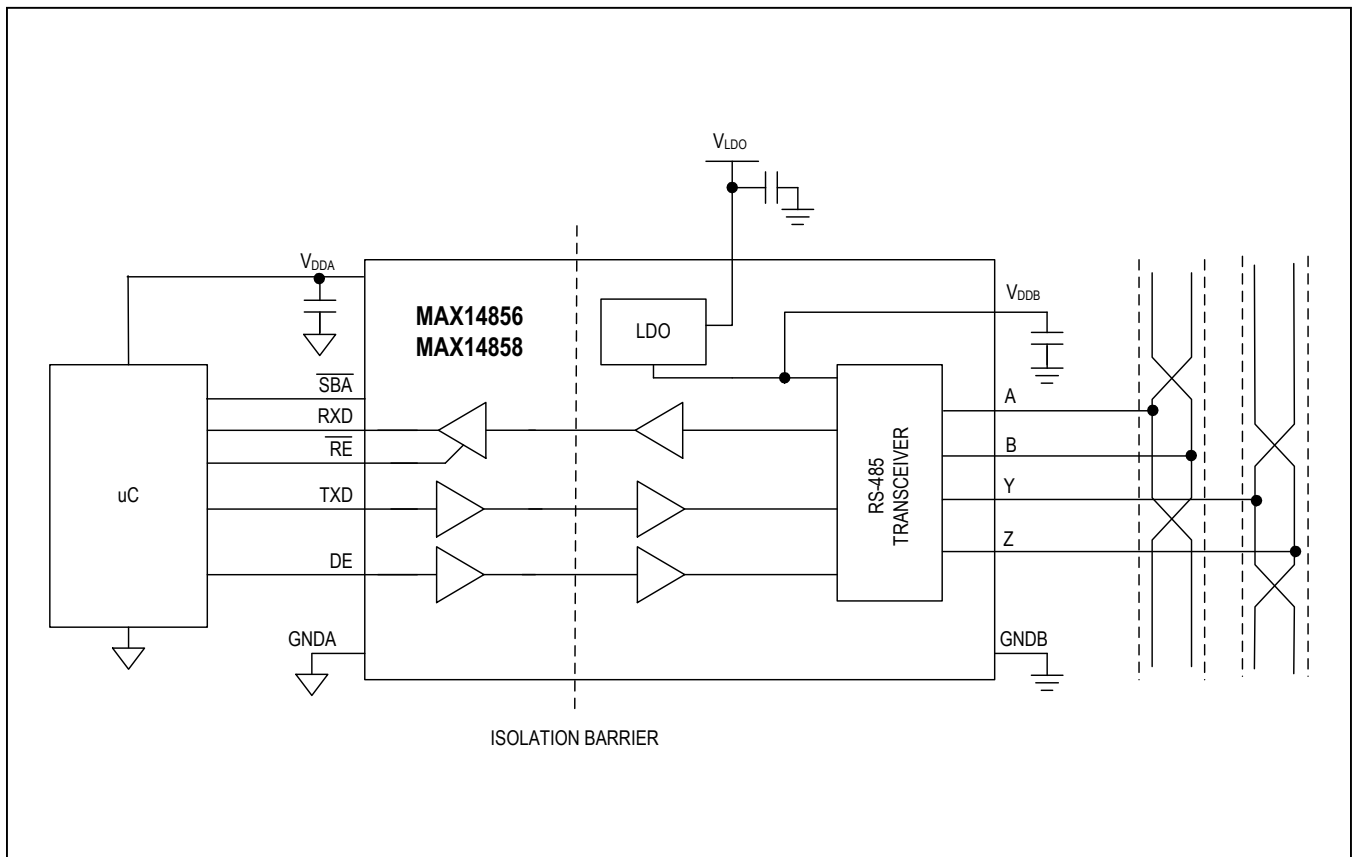


Figure 14. IEC 61000-4-2 ESD Generator Current Waveform

Typical Application Circuit



MAX14856/MAX14858

5kV<sub>RMS</sub> Isolated 500kbps/25Mbps Full-Duplex  
RS-485/RS-422 Transceivers  
with ±35kV ESD Protection

### Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
<b>MAX14856GWE+</b>	-40°C to +105°C	16 SOIC (W)
MAX14856GWE+T	-40°C to +105°C	16 SOIC (W)
<b>MAX14858GWE+</b>	-40°C to +105°C	16 SOIC (W)
MAX14858GWE+T	-40°C to +105°C	16 SOIC (W)

+Denotes a lead(Pb)-free/RoHS-compliant package.  
T = Tape and Reel.

### 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.
16 SOIC	W16M+9	<a href="#">21-0042</a>	<a href="#">90-0107</a>