

# ±15kV ESD-Protected, 460kbps, RS-232 Transmitters in SOT23-6

## ABSOLUTE MAXIMUM RATINGS

|  |                 |   |                 |
|--|-----------------|---|-----------------|
| V <sub>CC</sub> to GND (Note 1).....             | -0.3V to +13.2V | Continuous Power Dissipation (T <sub>A</sub> = +70°C) |                 |
| V <sub>EE</sub> to GND (Note 1).....             | +0.3V to -13.2V | 6-Pin SOT23 (derate 8.7mW/°C above +70°C).....        | 691mW           |
| V <sub>CC</sub> to V <sub>EE</sub> (Note 1)..... | +22V            | Operating Temperature Range .....                     | -40°C to +85°C  |
| TIN, SHDN to GND .....                           | -0.3V to +7V    | Junction Temperature .....                            | +150°C          |
| TOUT to GND (SHDN = GND).....                    | ±13.2V          | Storage Temperature Range .....                       | -65°C to +150°C |
| Output Short-Circuit to GND Duration.....        | Continuous      | Lead Temperature (soldering, 10s) .....               | +300°C          |

**Note 1:** V<sub>CC</sub> and V<sub>EE</sub> can have maximum magnitudes of 13.2V, but their absolute difference cannot exceed 22V.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub> = +7.5V to +12V, V<sub>EE</sub> = -7.5V to -12V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>CC</sub> = +10V, V<sub>EE</sub> = -10V, and T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                      | SYMBOL            | CONDITIONS  | MIN  | TYP   | MAX  | UNITS |
|--------------------------------|-------------------|---|------|-------|------|-------|
| <b>DC CHARACTERISTICS</b>      |                   |   |      |       |      |       |
| Positive Supply Voltage        | V <sub>CC</sub>   |   | 7.5  |       | 12   | V     |
| Negative Supply Voltage        | V <sub>EE</sub>   |   | -12  |       | -7.5 | V     |
| Positive Supply Current        | I <sub>CC</sub>   | V <sub>SHDN</sub> = +5V   |      |       | 250  | μA    |
| Negative Supply Current        | I <sub>EE</sub>   | V <sub>SHDN</sub> = +5V   | -125 |       |      | μA    |
| Shutdown Supply Current        |                   | V <sub>SHDN</sub> = 0   |      | ±0.4  | ±10  | μA    |
| <b>INPUT LOGIC (TIN, SHDN)</b> |                   |   |      |       |      |       |
| Input Logic Threshold Low      | V <sub>IL</sub>   |   |      |       | 0.8  | V     |
| Input Logic Threshold High     | V <sub>IH</sub>   |   | 2.4  |       |      | V     |
| Input Leakage                  |                   |   |      | ±0.01 | ±1   | μA    |
| TIN Input Hysteresis           |                   |   |      | 100   |      | mV    |
| <b>TRANSMITTER OUTPUT</b>      |                   |   |      |       |      |       |
| Output Voltage Swing           | V <sub>TOUT</sub> | V <sub>CC</sub> = 7.5V, V <sub>EE</sub> = -7.5V, R <sub>L</sub> = 3kΩ   | ±5   |       |      | V     |
|                                |                   | V <sub>CC</sub> = 6V, V <sub>EE</sub> = -6V, R <sub>L</sub> = 3kΩ   | ±3.7 |       |      | V     |
| Output Resistance              | R <sub>TOUT</sub> | V <sub>CC</sub> = V <sub>EE</sub> = 0, V <sub>TOUT</sub> = ±2V  | 300  |       |      | Ω     |
| Output Short-Circuit Current   |                   |   |      | ±35   | +60  | mA    |
| Output Leakage Current         | I <sub>TOUT</sub> | V <sub>TOUT</sub> = ±12V; V <sub>CC</sub> = 0 or V <sub>CC</sub> = +10V, V <sub>EE</sub> = -10V; SHDN = GND   |      |       | ±100 | μA    |
| <b>TIMING CHARACTERISTICS</b>  |                   |   |      |       |      |       |
| Maximum Data Rate              |                   | R <sub>L</sub> = 3kΩ, C <sub>L</sub> = 1000pF   | 460  |       |      | kbps  |
| Transmitter Skew               | t <sub>TS</sub>   | I <sub>tPHL</sub> - t <sub>tLH</sub> , Figure 1   |      | 100   |      | ns    |
| Transition-Region Slew Rate    |                   | R <sub>L</sub> = 3kΩ to 7kΩ, C <sub>L</sub> = 300pF to 1000pF, measured from -3V to +3V or +3V to -3V, V <sub>CC</sub> = +10V, V <sub>EE</sub> = -10V, T <sub>A</sub> = +25°C | 6    |       | 30   | V/μs  |
| Transmitter Enable Time        | t <sub>EN</sub>   |   |      | 2     |      | μs    |

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**MAX3190/MAX3190E**

## ELECTRICAL CHARACTERISTICS (continued)

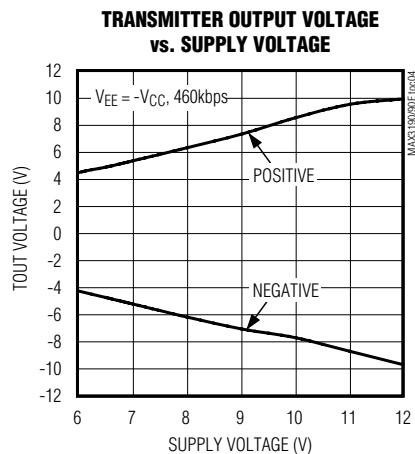
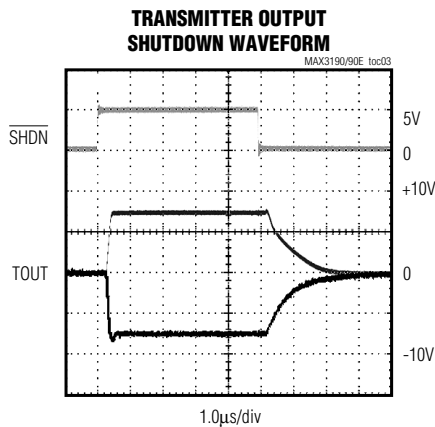
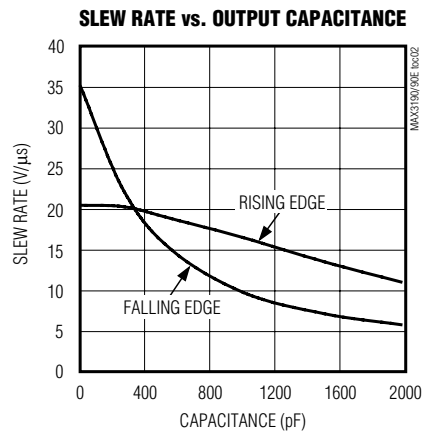
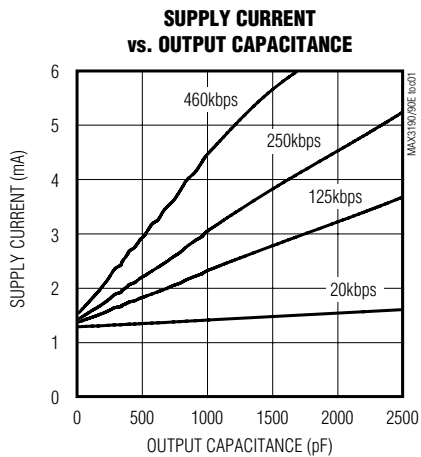
( $V_{CC} = +7.5V$  to  $+12V$ ,  $V_{EE} = -7.5V$  to  $-12V$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $V_{CC} = +10V$ ,  $V_{EE} = -10V$ , and  $T_A = +25^\circ C$ .) (Note 2)

| PARAMETER                        | SYMBOL | CONDITIONS                     | MIN | TYP | MAX | UNITS |
|----------------------------------|--------|--------------------------------|-----|-----|-----|-------|
| <b>ESD PROTECTION (MAX3190E)</b> |        |                                |     |     |     |       |
| TOUT                             |        | Human Body Model               |     | ±15 |     | kV    |
|                                  |        | IEC 1000-4-2 Contact Discharge |     | ±8  |     |       |
|                                  |        | IEC 1000-4-2 Air-Gap Discharge |     | ±15 |     |       |

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

## Typical Operating Characteristics

( $V_{CC} = +10V$ ,  $V_{EE} = -10V$ ,  $R_L = 3k\Omega$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)



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## Pin Description

| PIN | NAME                     | FUNCTION  |
|-----|--------------------------|---|
| 1   | $\overline{\text{SHDN}}$ | Active-Low Shutdown. Pull low to reduce the supply current and to force TOUT into a high-impedance state. |
| 2   | GND                      | Ground  |
| 3   | TIN                      | TTL/CMOS Transmitter Input  |
| 4   | TOUT                     | RS-232 Transmitter Output   |
| 5   | VEE                      | Negative Supply Voltage   |
| 6   | VCC                      | Positive Supply Voltage   |

## Detailed Description

The MAX3190/MAX3190E are EIA/TIA-232 transmitters that convert CMOS/TTL logic levels to RS-232 signals. They operate on ±7.5V to ±12V supplies and feature enhanced electrostatic discharge protection (see *ESD Protection*). The MAX3190/MAX3190E guarantee a 460kbps data rate with worst-case loads of 3kΩ in parallel with 1000pF. The MAX3190/MAX3190E invert the TOUT signal relative to TIN (standard RS-232). The transmitter input does not have a pullup resistor and should be connected to GND if unused.

### Shutdown

The MAX3190/MAX3190E feature a shutdown input. Drive  $\overline{\text{SHDN}}$  low to reduce the supply current to 1μA (max). Shutdown also forces TOUT into a high-impedance state, allowing the signal line to be safely controlled by other transmitters. Drive  $\overline{\text{SHDN}}$  high for normal operation.

### ESD Protection

As with all Maxim devices, ESD protection structures are incorporated on all pins to protect against ESD encountered during handling and assembly. The MAX3190E's transmitter output has extra protection against static electricity. Maxim has developed state-of-the-art structures enabling this pin to withstand ESD up to ±15kV without damage or latch-up. The MAX3190E's transmitter output is characterized for protection to the following limits:

- ±15kV using the Human Body Model
- ±8kV using the Contact Discharge method specified in IEC 1000-4-2
- ±15kV using the Air-Gap Discharge method specified in IEC 1000-4-2

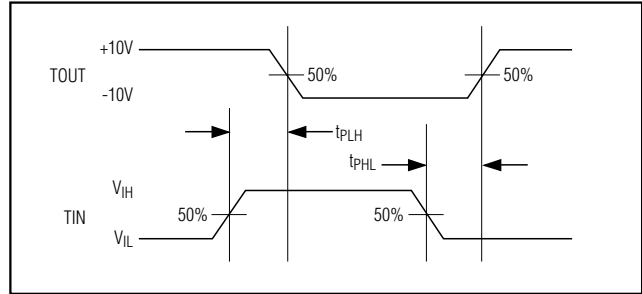


Figure 1. Transmitter Propagation-Delay Timing

### Human Body Model

Figure 2 shows the Human Body Model, and Figure 3 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, and 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 ICs. The MAX3190E enables the design of equipment that meets the highest level (Level 4) 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, the ESD withstand voltage measured to this standard is generally lower than that measured using the Human Body. Figure 4 shows the IEC 1000-4-2 model, and Figure 5

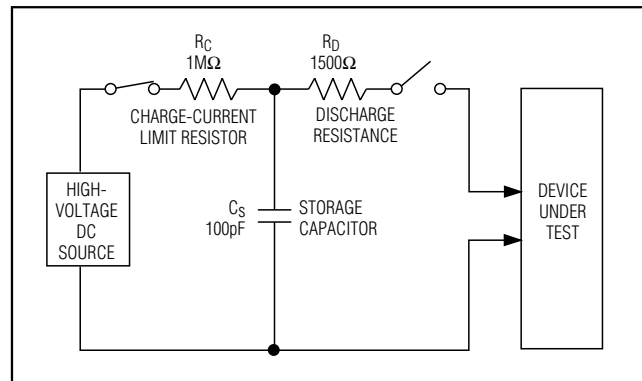


Figure 2. Human Body ESD Test Model

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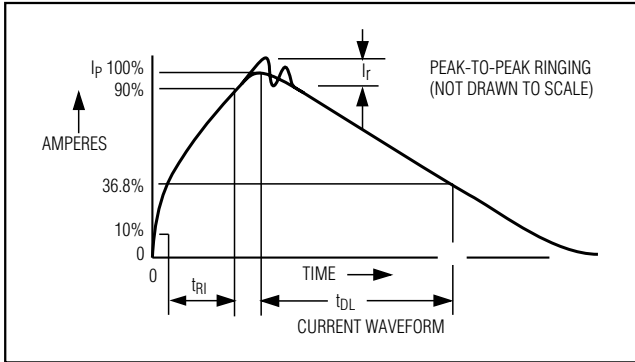


Figure 3. Human Body Model Current Waveform

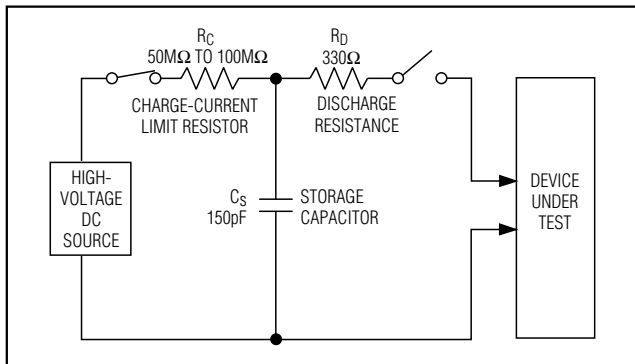


Figure 4. IEC 1000-4-2 ESD Test Model

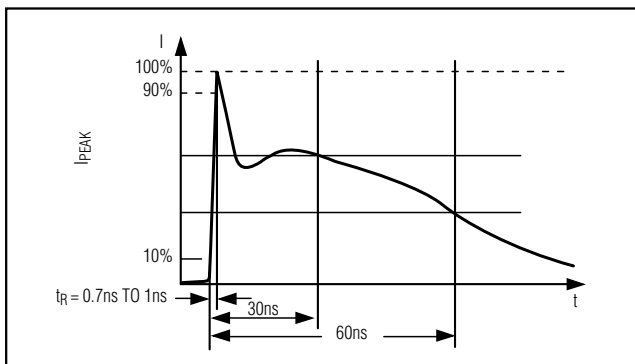


Figure 5. IEC 1000-4-2 Generator Current Waveform

shows the current waveform for the ±8kV 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.

### Power-Supply Decoupling

In most circumstances, 0.1µF bypass capacitors are adequate for power-supply decoupling. Connect the bypass capacitors as close to the IC as possible.

### Applications Information

#### Power-Supply Sources

The MAX3190/MAX3190E require ±7.5V to ±12V dual supplies. For applications where these supply voltages are not present, a DC-DC converter must be added. Due to the MAX3190/MAX3190E's low current consumption, a charge pump can provide the proper supply voltages and requires a minimal amount of board space and cost.

When using another RS-232 device containing an internal unregulated charge pump (Tables 1 and 2), the MAX3190/MAX3190E may be powered from the internal charge pump (Figure 6). This eliminates the need for additional external DC-DC converters to generate the required ±7.5V to ±12V dual supplies. The MAX3190/MAX3190E are specifically designed to be used with Maxim's RS-232 products listed in Tables 1 and 2. Competitive RS-232 devices' charge pumps typically do not have the capability to power these devices.

The MAX3190/MAX3190E can be operated from ±6V to ±7.5V supplies. In this condition, the devices are guaranteed to be RS-232-compatible (TOUT ≥ +3.7V).

For applications that have ±4.5V to ±6V supplies available, please refer to the MAX3188/MAX3189 or MAX3188E/MAX3189E data sheet.

**$\pm 15\text{kV}$  ESD-Protected, 460kbps, RS-232 Transmitters in SOT23-6**

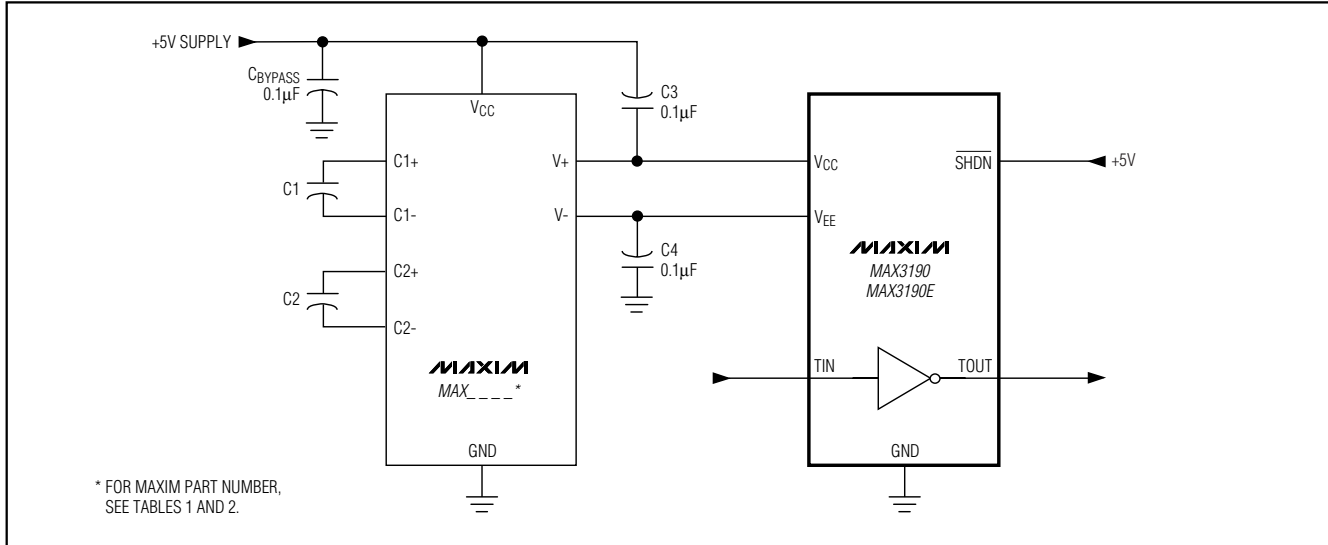


Figure 6. Powering the MAX3190/MAX3190E

# **±15kV ESD-Protected, 460kbps, RS-232 Transmitters in SOT23-6**

**MAX3188E/MAX3189E**

**Table 1. RS-232 Devices with Internal Unregulated Charge Pumps of ±10V (typical)**

| PART NUMBER | NO. OF TX/RX | DATA RATE (kbps) |
|-------------|--------------|------------------|
| MAX200      | 5/0          | 120              |
| MAX201      | 2/2          | 120              |
| MAX202      | 2/2          | 64               |
| MAX203      | 2/2          | 120              |
| MAX204      | 4/0          | 120              |
| MAX205      | 5/5          | 120              |
| MAX206      | 4/3          | 120              |
| MAX207      | 5/3          | 120              |
| MAX208      | 4/4          | 120              |
| MAX209      | 3/5          | 120              |
| MAX211      | 4/5          | 120              |
| MAX213      | 4/5          | 120              |
| MAX220      | 2/2          | 120              |
| MAX221      | 1/1          | 250              |
| MAX222      | 2/2          | 200              |
| MAX223      | 4/5          | 120              |
| MAX225      | 5/5          | 120              |
| MAX230      | 5/0          | 120              |
| MAX231      | 2/2          | 120              |
| MAX232      | 2/2          | 120              |
| MAX232A     | 2/2          | 200              |
| MAX233A     | 2/2          | 200              |
| MAX233      | 2/2          | 120              |
| MAX234      | 4/0          | 120              |
| MAX235      | 5/5          | 120              |
| MAX236      | 4/3          | 120              |
| MAX237      | 5/3          | 120              |
| MAX238      | 4/4          | 120              |
| MAX239      | 3/5          | 120              |
| MAX240      | 5/5          | 120              |
| MAX241      | 4/5          | 120              |
| MAX242      | 2/2          | 200              |
| MAX243      | 2/2          | 200              |
| MAX244      | 8/10         | 120              |
| MAX248      | 8/8          | 120              |
| MAX249      | 6/10         | 120              |

**Table 2. ±15kV ESD-Protected RS-232 Devices with Internal Unregulated Charge Pumps of ±10V (typical)**

| PART NUMBER | NO. OF TX/RX | DATA RATE (kbps) |
|-------------|--------------|------------------|
| MAX202E     | 2/2          | 64               |
| MAX203E     | 2/2          | 120              |
| MAX205E     | 5/5          | 120              |
| MAX206E     | 4/3          | 120              |
| MAX207E     | 5/3          | 120              |
| MAX208E     | 4/4          | 120              |
| MAX211E     | 4/5          | 120              |
| MAX213E     | 4/5          | 120              |
| MAX221E     | 1/1          | 250              |
| MAX241E     | 4/5          | 120              |

### **Chip Information**

TRANSISTOR COUNT: 75  
PROCESS: CMOS

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## Package Information

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

| SYMBOL | MIN      | MAX  |
|--------|----------|------|
| A      | 0.90     | 1.45 |
| A1     | 0.00     | 0.15 |
| A2     | 0.90     | 1.30 |
| b      | 0.35     | 0.50 |
| C      | 0.08     | 0.20 |
| D      | 2.80     | 3.00 |
| E      | 2.60     | 3.00 |
| E1     | 1.50     | 1.75 |
| L      | 0.35     | 0.55 |
| e      | 0.95 REF |      |
| a      | 0°       | 10°  |

**NOTES:**  
 1. ALL DIMENSIONS ARE IN MILLIMETERS.  
 2. FOOT LENGTH MEASURED AT INTERCEPT POINT BETWEEN DATUM A & LEAD SURFACE.  
 3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR.  
 4. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.  
 5. PIN 1 IS LOWER LEFT PIN WHEN READING TOP MARK FROM LEFT TO RIGHT. (SEE EXAMPLE TOP MARK)  
 6. PIN 1 I.D. DOT IS 0.3 MM Ø MIN. LOCATED ABOVE PIN 1.  
 7. MEETS JEDEC MO178.

**MAXIM**  
 PROPRIETARY INFORMATION  
 TITLE: PACKAGE OUTLINE, SOT-23, 6L  
 APPROVAL: \_\_\_\_\_ DOCUMENT CONTROL NO. 21-0058 REV E 1/1

6LS0TEPS

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