



# ±15kV ESD-Protected, 12V, Dual RS-232 Serial Port with Low-Power Standby for Motherboards/Desktops

MAX3209E

## General Description

The MAX3209E is a complete, dual DTE RS-232 serial port (6 transmitters, 10 receivers) for motherboards and desktop PCs that ensures compliance with the stringent ESD requirements of the European Community. The device minimizes board space and power consumption by eliminating the need for a negative power supply; it integrates two serial ports and a charge pump into a single 38-pin TSSOP package.

The MAX3209E features a 50µA low-power standby mode for compliance with system power-management requirements. During standby, while the device operates from the single +3V to +5.5V logic supply, one receiver on each port remains active, allowing automatic system wake-up when peripheral communications resume.

All transmitter outputs and receiver inputs are protected to ±15kV using IEC 1000-4-2 Air-Gap Discharge, ±8kV using IEC 1000-4-2 Contact Discharge, and ±15kV using the Human Body Model, making the device ideal for use in harsh environments or mission-critical equipment. In addition, the MAX3209E withstands ±4kV per IEC 1000-4-4 Electrical Fast Transient/Burst Stressing. As a result of its robust charge-pump structure, the MAX3209E guarantees mouse driveability and true RS-232 operation at data rates up to 460kbps, ensuring compatibility with PC-to-PC communication software (such as LapLink™).

## Applications

Desktop PCs  
Motherboards  
Instruments  
Equipment Requiring IEC 1000-4-2 Compliance  
Telecommunications  
Network Servers

*Typical Operating Circuit appears at end of data sheet.*

*Pin Configurations continued at end of data sheet.*

LapLink is a trademark of Traveling Software.

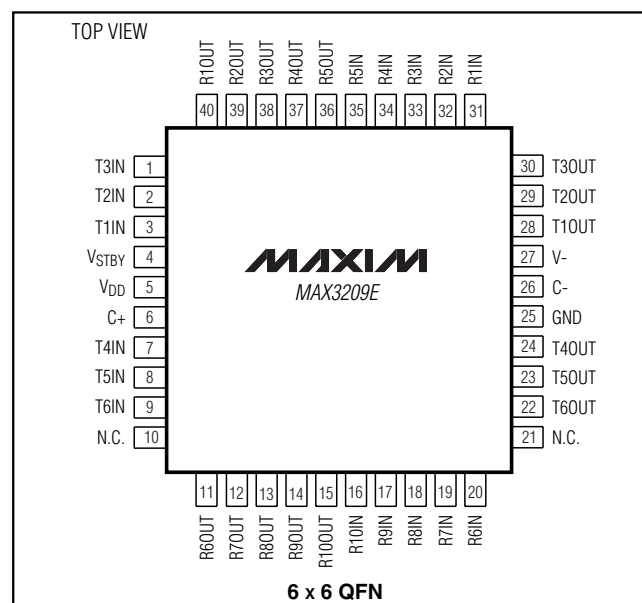
## Features

- ◆ Two Complete Serial Ports in a Single 38-Pin TSSOP Package
- ◆ Requires Only +12V Supply and Logic Supply (+3V to +5.5V)
- ◆ No Negative Supply Required
- ◆ One Receiver Active per Port in Standby for System Wake-Up
- ◆ 460kbps Data Rate; LapLink Compatible
- ◆ Enhanced ESD Protection
  - ±15kV—Human Body Model
  - ±8kV—IEC 1000-4-2, Contact Discharge
  - ±15kV—IEC 1000-4-2, Air-Gap Discharge
- ◆ ±4kV Fast Transient Burst Immunity per IEC 1000-4-4
- ◆ Low 50µA Standby Current
- ◆ Operates with Either +3V or +5V Logic
- ◆ Guaranteed Mouse Driveability
- ◆ Small 0.1µF Capacitors
- ◆ Flow-Through Pinout

## Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX3209ECUU	0°C to +70°C	38 TSSOP
MAX3209EEUU	-40°C to +85°C	38 TSSOP
MAX3209EEGL	-40°C to +85°C	6 x 6 40 QFN

## Pin Configurations



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

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## ABSOLUTE MAXIMUM RATINGS

V <sub>DD</sub> .....	-0.3V to +15V	T <sub>OUT</sub> (one at a time) .....	Continuous
V <sub>STBY</sub> .....	-0.3V to +7V	R <sub>OUT</sub> (one at a time) .....	Continuous
V <sub>-</sub> .....	+0.3V to -15V	Continuous Power Dissipation (T <sub>A</sub> = +70°C)	
Input Voltages		TSSOP (derate 11.8mW/°C above +70°C) .....	941mW
T <sub>IN</sub> .....	-0.3V to +7V	QFN 6 × 6mm (derate 23.2mW/°C above +70°C) .....	1860mW
R <sub>IN</sub> .....	±30V	Operating Temperature Ranges	
Output Voltages		MAX3209EC _ _ .....	0°C to +70°C
T <sub>OUT</sub> .....	±15V	MAX3209EE _ _ .....	-40°C to +85°C
R <sub>OUT</sub> .....	-0.3V to (V <sub>STBY</sub> + 0.3V)	Storage Temperature Range .....	-65°C to +150°C
Short-Circuit Duration		Lead Temperature (soldering, 10s) .....	+300°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.

## ELECTRICAL CHARACTERISTICS

(V<sub>DD</sub> = +10.8V to +13.2V, V<sub>STBY</sub> = +3V to +5.5V, C1 = C2 = 0.1μF, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C, V<sub>DD</sub> = +12V, V<sub>STBY</sub> = +3.3V.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DC CHARACTERISTICS</b>						
Operating Voltage Range	V <sub>DD</sub>		10.8		13.2	V
	V <sub>STBY</sub>		3		5.5	
Supply Current	I <sub>DD</sub>	V <sub>DD</sub> = +12V, no load, all transmitter inputs at V <sub>STBY</sub> , all receiver inputs at V <sub>STBY</sub> or unconnected		0.5	1	mA
	I <sub>STBY</sub>	V <sub>DD</sub> = 0, V <sub>STBY</sub> = +3.3V, no load, all transmitter inputs at V <sub>STBY</sub> , all receiver inputs at V <sub>STBY</sub> or unconnected		50	100	μA
<b>TRANSMITTER LOGIC INPUTS</b>						
Input Logic Threshold Low	V <sub>ILT</sub>	T <sub>IN</sub>			0.4	V
Input Logic Threshold High	V <sub>IHT</sub>	T <sub>IN</sub> , V <sub>STBY</sub> = +3V to +5.25V	2.1			V
Input Pull-Up Current		Transmitter input at GND			25	μA
<b>RECEIVER LOGIC OUTPUTS</b>						
Output Voltage Low	V <sub>OLR</sub>	R <sub>OUT</sub> ; I <sub>SINK</sub> = 1.6mA			0.4	V
Output Voltage High	V <sub>OHR</sub>	R <sub>OUT</sub>	I <sub>SOURCE</sub> = 40μA	V <sub>STBY</sub> - 0.3		V
			I <sub>SOURCE</sub> = 1mA	V <sub>STBY</sub> - 0.6		
Receiver Output Leakage Current		V <sub>DD</sub> = 0, V <sub>STBY</sub> = 5V		0.05	±5	μA
<b>RS-232 TRANSMITTER OUTPUTS</b>						
Output Voltage Swing		All transmitter outputs loaded with 3kΩ to GND	±5.0			V
RS-232 Output Short-Circuit Current		V <sub>T_OUT</sub> = 0		±10	±60	mA
Transmitter Output Resistance		V <sub>DD</sub> = V <sub>STBY</sub> = 0, V <sub>OUT</sub> = ±2V	300			Ω
<b>RS-232 RECEIVER INPUTS</b>						
Receiver Input Voltage Range			-25		25	V
RS-232 Input Threshold Low		T <sub>A</sub> = +25°C		0.4		V
RS-232 Input Threshold High		T <sub>A</sub> = +25°C	2.4			V
RS-232 Input Hysteresis		V <sub>STBY</sub> = 3.3V	0.2		1	V
RS-232 Input Resistance		T <sub>A</sub> = +25°C	3	5	7	kΩ

# ±15kV ESD-Protected, 12V, Dual RS-232 Serial Port with Low-Power Standby for Motherboards/Desktops

**MAX3209E**

## ELECTRICAL CHARACTERISTICS (continued)

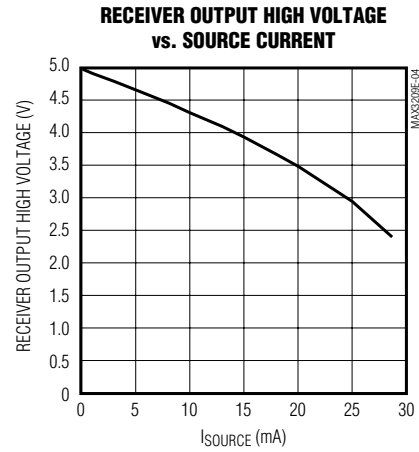
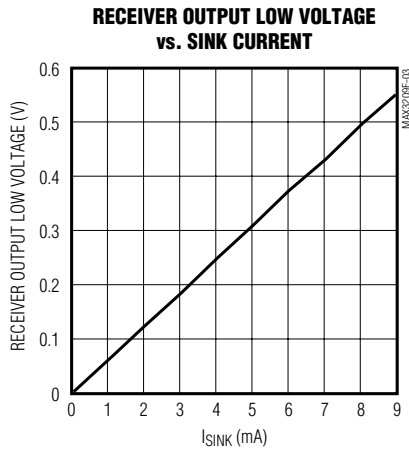
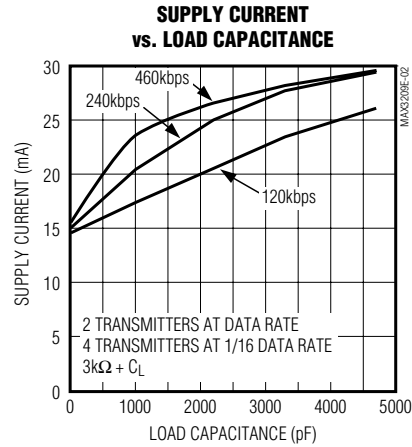
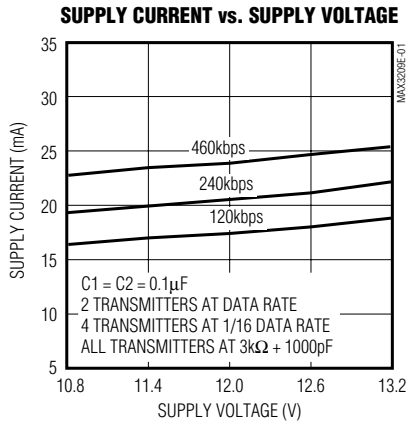
(V<sub>DD</sub> = +10.8V to +13.2V, V<sub>STBY</sub> = +3V to +5.5V, C<sub>1</sub> = C<sub>2</sub> = 0.1μF, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C, V<sub>DD</sub> = +12V, V<sub>STBY</sub> = +3.3V.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
<b>ESD/BURST CHARACTERISTICS</b>							
ESD Protection		Human Body Model	±15			kV	
		IEC 1000-4-2 (Contact Discharge)	±8				
		IEC 1000-4-2 (Air-Gap Discharge)	±15				
Electrical Fast Transient/Burst Immunity		IEC 1000-4-4	±4			kV	
<b>TRANSMITTER TIMING CHARACTERISTICS</b> (Figure 1)							
Data Rate	DR	R <sub>L</sub> = 3kΩ to 7kΩ, C <sub>L</sub> = 50pF to 1000pF, two transmitters switching	460			kbps	
Mouse Driveability		T1IN = T2IN = GND, T3IN = V <sub>CC</sub> , T3OUT loaded with 3kΩ to GND, T1OUT and T2OUT loaded with 2.5mA each	+6		-5	V	
Transmitter Output Propagation Delay, Low to High	t <sub>PLHT</sub>	C <sub>L</sub> = 1000pF	1			μs	
Transmitter Output Propagation Delay, High to Low	t <sub>PHLT</sub>	C <sub>L</sub> = 1000pF	1			μs	
Transmitter Output Slew Rate	SR	R <sub>L</sub> = 3kΩ to 7kΩ, V <sub>STBY</sub> = 3.3V, C <sub>L</sub> = 50pF to 470pF, T <sub>A</sub> = +25°C, measured from +3V to -3V or -3V to +3V	6	12	30	V/μs	
		R <sub>L</sub> = 3kΩ to 7kΩ, V <sub>STBY</sub> = 3.3V, C <sub>L</sub> = 50pF to 1000pF, T <sub>A</sub> = +25°C, measured from +3V to -3V or -3V to +3V	4	12	30		
<b>RECEIVER TIMING CHARACTERISTICS</b>							
Receiver Output Propagation Delay, Low to High	t <sub>PLHR</sub>	C <sub>L</sub> = 150pF	0.4			1	μs
Receiver Output Propagation Delay, High to Low	t <sub>PHLR</sub>	C <sub>L</sub> = 150pF	0.4			1	μs

# ±15kV ESD-Protected, 12V, Dual RS-232 Serial Port with Low-Power Standby for Motherboards/Desktops

## Typical Operating Characteristics

(V<sub>STBY</sub> = +5V, V<sub>DD</sub> = +12V, C<sub>1</sub> = C<sub>2</sub> = 0.1μF, T<sub>A</sub> = +25°C, unless otherwise noted.)



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**MAX3209E**

## Pin Description

PIN		NAME	FUNCTION
TSSOP	QFN		
1–5, 15–19	11–15, 36–40	R_OUT	TTL/CMOS Receiver Outputs
6, 7, 8, 12, 13, 14	1, 2, 3, 7, 8, 9	T_IN	TTL/CMOS Transmitter Inputs
9	4	V_STBY	Standby Power Supply for R5 and R10
10	5	V_DD	+12V Single-Supply Voltage
11	6	C+	Positive Terminal of the Inverting Charge-Pump Capacitor
20–24, 34–38	16–20, 31–35	R_IN	RS-232 Receiver Inputs
25, 26, 27, 31, 32, 33	22, 24, 28, 30	T_OUT	RS-232 Transmitter Outputs
28	25	GND	Ground (for QFN package, connect the exposed pad and corner tabs to GND)
29	26	C-	Negative Terminal of the Inverting Charge-Pump Capacitor
30	27	V-	-12V Generated by the Inverting Charge Pump
—	10, 21	N.C.	No Connection. Not internally connected.

## Detailed Description

### ±15kV ESD Protection

As with all Maxim devices, ESD-protection structures are incorporated on all pins to protect against electrostatic discharges (ESD) encountered during handling and assembly. The MAX3209E driver outputs and receiver inputs have extra protection against static electricity found in normal operation. Maxim's engineers developed state-of-the-art structures to protect these pins against ±15kV ESD, without damage. After an ESD event, the MAX3209E continues working without latchup.

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

- 1) ±15kV using the Human Body Model
- 2) ±8kV using the Contact-Discharge Method specified in IEC 1000-4-2 (formerly IEC 801-2)
- 3) ±15kV using the Air-Gap Method specified in IEC 1000-4-2 (formerly IEC 801-2)

### ESD Test Conditions

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

#### Human Body Model

Figure 2a shows the Human Body Model, and Figure 2b 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 device through a 1.5kΩ resistor.

#### IEC 1000-4-2

Since January 1996, all equipment manufactured and/or sold in the European community has been required to meet the stringent IEC 1000-4-2 specification. The IEC 1000-4-2 standard covers ESD testing and performance of finished equipment; it does not specifically refer to integrated circuits. The MAX3209E helps you design equipment that meets Level 4 (the highest level) of IEC 1000-4-2, without additional ESD-protection components.

The main 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 ESD test model (Figure 3a), the ESD withstand voltage measured to this standard is generally lower than that measured using the Human Body Model. Figure 3b 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 charge probe. The Contact-Discharge method connects the probe to the device before the probe is energized.

#### Machine Model

The Machine Model for ESD testing uses a 200pF storage capacitor and zero-discharge resistance. It mimics the stress caused by handling during manufacturing and assembly. Of course, all pins (not just RS-232

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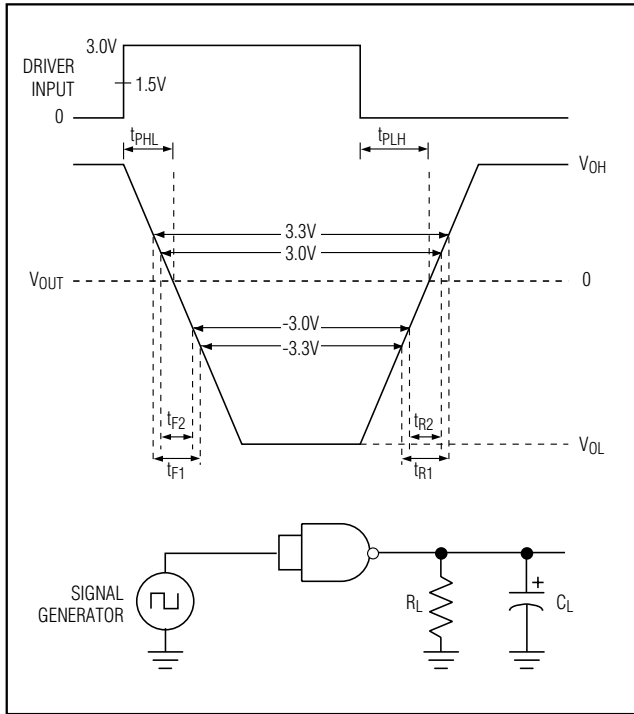


Figure 1. Slew-Rate Test Circuit and Timing Diagram

inputs and outputs) require this protection during manufacturing. Therefore, the Machine Model is less relevant to the I/O ports than are the Human Body Model and IEC 1000-4-2.

## ±4kV Electrical Fast Transient/Burst Testing (IEC 1000-4-4)

IEC 1000-4-4 Electrical Fast Transient/Burst (EFT/B) is an immunity test for the evaluation of electrical and electronic systems during operating conditions. The test was adapted for evaluation of integrated circuits with power applied. Repetitive fast transients with severe pulsed EMI were applied to signal and control ports. Over 15,000 distinct discharges per minute are sent to each interface port of the IC or equipment under test (EUT) simultaneously with a minimum test duration time of one minute. This simulates stress due to displacement current from electrical transients on AC mains, or other telecommunication lines in close proximity. Short rise times and very specific repetition rates are essential to the validity of the test.

Stress placed on the EUT is severe. In addition to the controlled individual discharges placed on the EUT, extraneous noise and ringing on the transmission line can multiply the number of discharges as well as

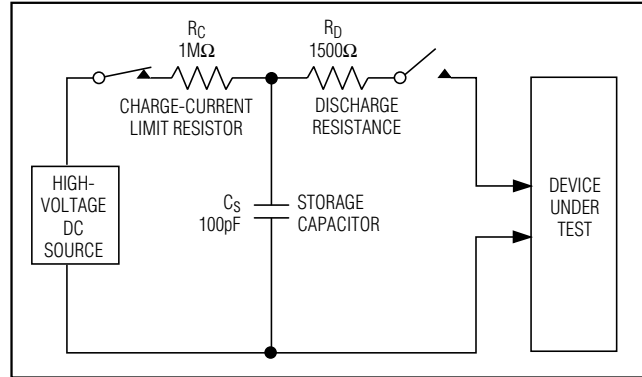


Figure 2a. Human Body ESD Test Model

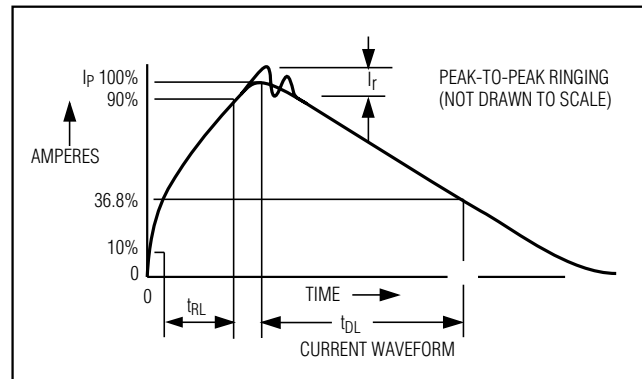


Figure 2b. Human Body Model Current Waveform

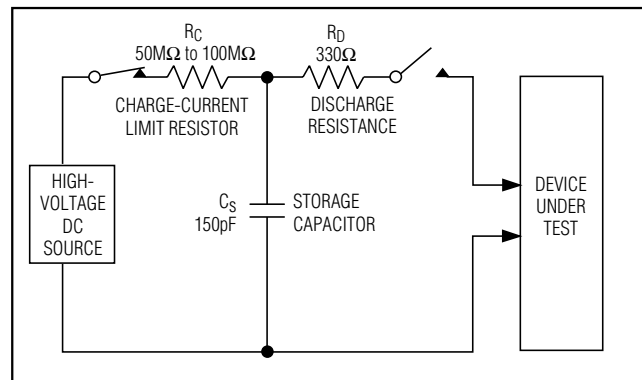


Figure 3a. IEC 1000-4-2 ESD Test Model

increase the magnitude of each discharge. All cabling was left unterminated to simulate worst case reflections.

The MAX3209E was set up as specified in IEC 1000-4-4 and the *Typical Operating Circuit* of this data sheet. The amplitude, pulse rise time, pulse duration, pulse repetition period, burst duration, and burst period (Figure 5) of the burst generator were all verified with a

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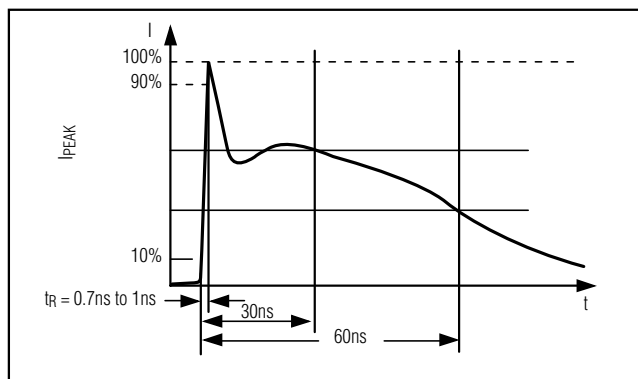


Figure 3b. IEC 1000-4-2 ESD-Generator Current Waveform

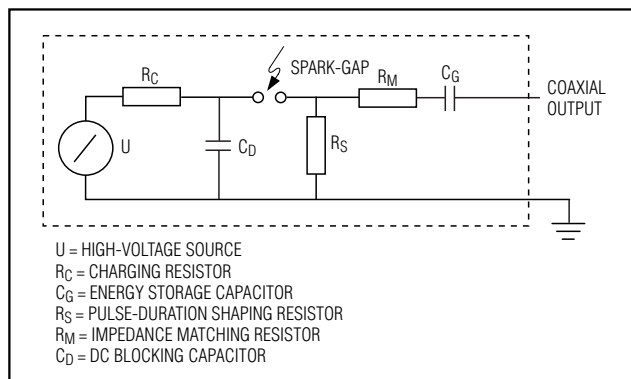


Figure 4. Simplified circuit diagram of a fast transient/burst generator

digital oscilloscope according to the specifications in IEC 1000-4-4 sec. 6.1.1 and 6.1.2. A simplified diagram of the EFT/B generator is shown in Figure 4. The burst stresses were applied to R11N–R10IN and T1OUT–T6OUT simultaneously.

IEC 1000-4-4 provides several levels of test severity (see Table 1). The MAX3209E passes the 4000V stress, a special category “X” the beyond the highest level for severe (transient) industrial environments for telecommunication lines.

The stresses are applied while the MAX3209E is powered up. Test results are reported as:

- 1) Normal performance within the specification limits.
- 2) Temporary degradation or loss of function or performance which is self-recoverable.
- 3) Temporary degradation, loss of function or performance requiring operator intervention, such as system reset.
- 4) Degradation or loss of function not recoverable due to damage.

The MAX3209E meets classification 2 listed above. Additionally, the MAX3209E will not latchup during the IEC burst stress events.

## Applications Information

### R5 and R10 Active in Standby Mode

The MAX3209E is placed in standby mode when  $V_{DD}$  is not present, provided that  $V_{STBY}$  remains at +3V to +5.5V. In standby mode, receivers R5 and R10 remain active, consuming 100 $\mu$ A max while unloaded. Standby mode allows activity to be sensed on the serial ports so that main power can be restored by the power-management unit, as shown in Figure 6.

## Layout Considerations

Use proper layout to ensure other devices on your board are not damaged in an ESD strike. Currents as high as 60A can instantaneously pass into ground, so be sure to minimize the ground-lead return path to the power supply. A separate return path to the power supply is recommend. Trace widths should be greater than 40 mils. Bypass  $V_{DD}$  and  $V_{STBY}$  with 0.1 $\mu$ F capacitors as close to the part as possible to ensure maximum ESD protection.

The MAX3209E is not sensitive to power-supply sequencing, and therefore requires no external protection diodes.

### Interconnection with 3V and 5V Logic

The MAX3209E can directly interface with various 3V and 5V logic families, including ACT and HCT CMOS. See Table 2 for more information on possible combinations of interconnections.

### Mouse Driveability

The MAX3209E has been specifically designed to power serial mice while operating from low-voltage power supplies. It has been tested with leading mouse brands from manufacturers such as Microsoft and Logitech. The MAX3209E successfully drove all serial mice tested and met their respective current and voltage requirements.



# ±15kV ESD-Protected, 12V, Dual RS-232 Serial Port with Low-Power Standby for Motherboards/Desktops

**Table 1. Test Severity Levels for Communication Lines**

LEVEL	ON I/O, SIGNAL, DATA, AND CONTROL PORTS	EFT	INDUSTRIAL ELECTROMAGNETIC ENVIRONMENT
	PEAK VOLTAGE	REPETITION RATE (kHz)	
1	250	5	Well protected
2	500	5	Protected
3	1000	5	Typical
4	2000	5	Severe
X	4000	5	MAX3209E

**Table 2. Logic Family Compatibility with Various Supply Voltages**

SYSTEM POWER-SUPPLY VOLTAGE (V)	V <sub>STBY</sub> SUPPLY VOLTAGE (V)	COMPATIBILITY
3.3	3.3	Compatible with all CMOS families.
5	5	Compatible with all TTL and CMOS families.
5	3.3	Compatible with ACT and HCT CMOS, and with AC, HC, or CD4000 CMOS.

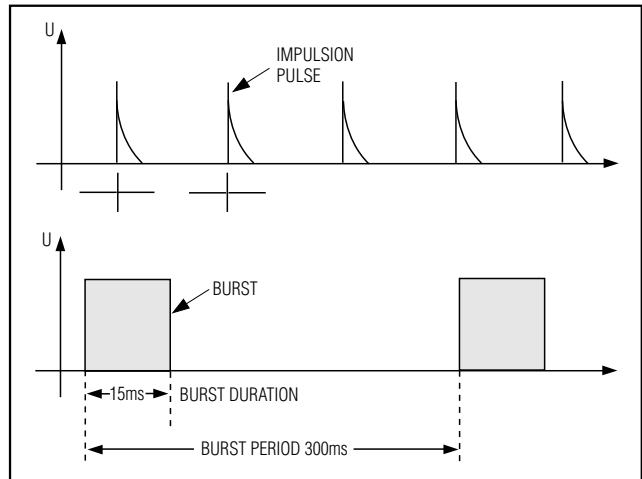


Figure 5. General Graph of a Fast Transient Burst

## Chip Information

TRANSISTOR COUNT: 774

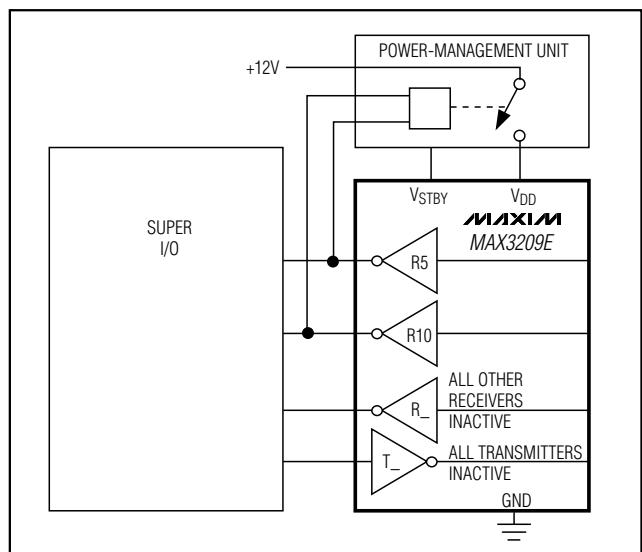
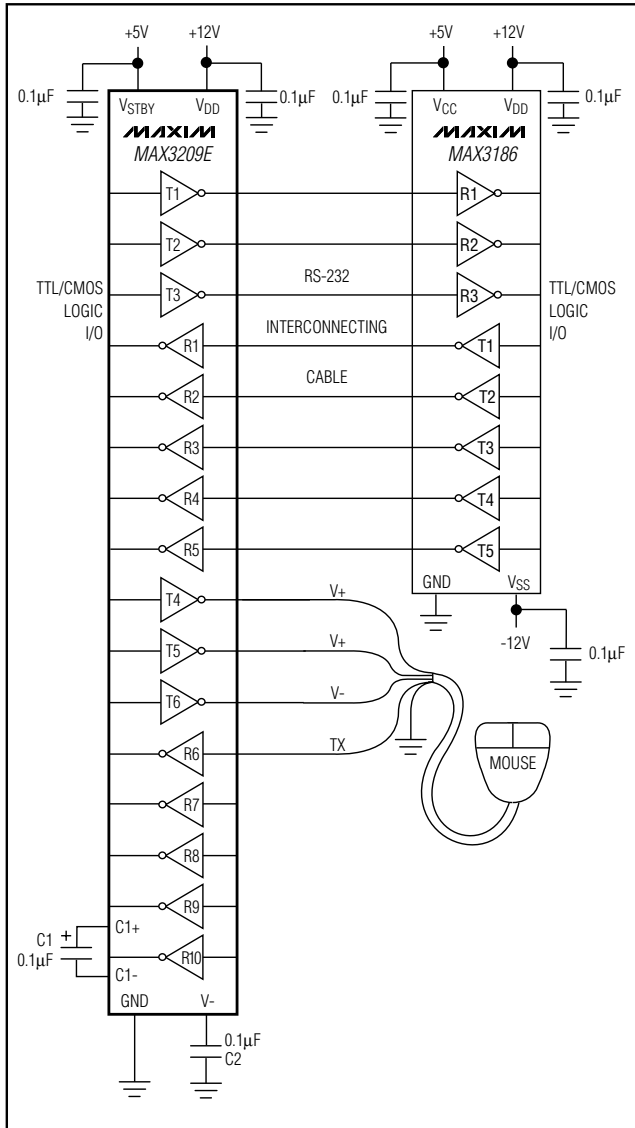


Figure 6. MAX3209E in Standby Mode

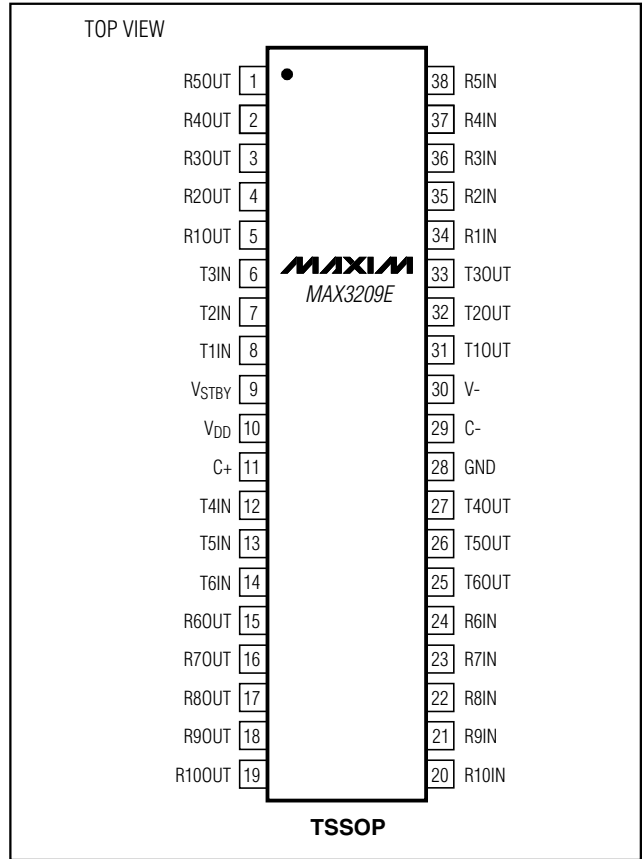


# ±15kV ESD-Protected, 12V, Dual RS-232 Serial Port with Low-Power Standby for Motherboards/Desktops

## Typical Operating Circuit



## Pin Configurations (continued)

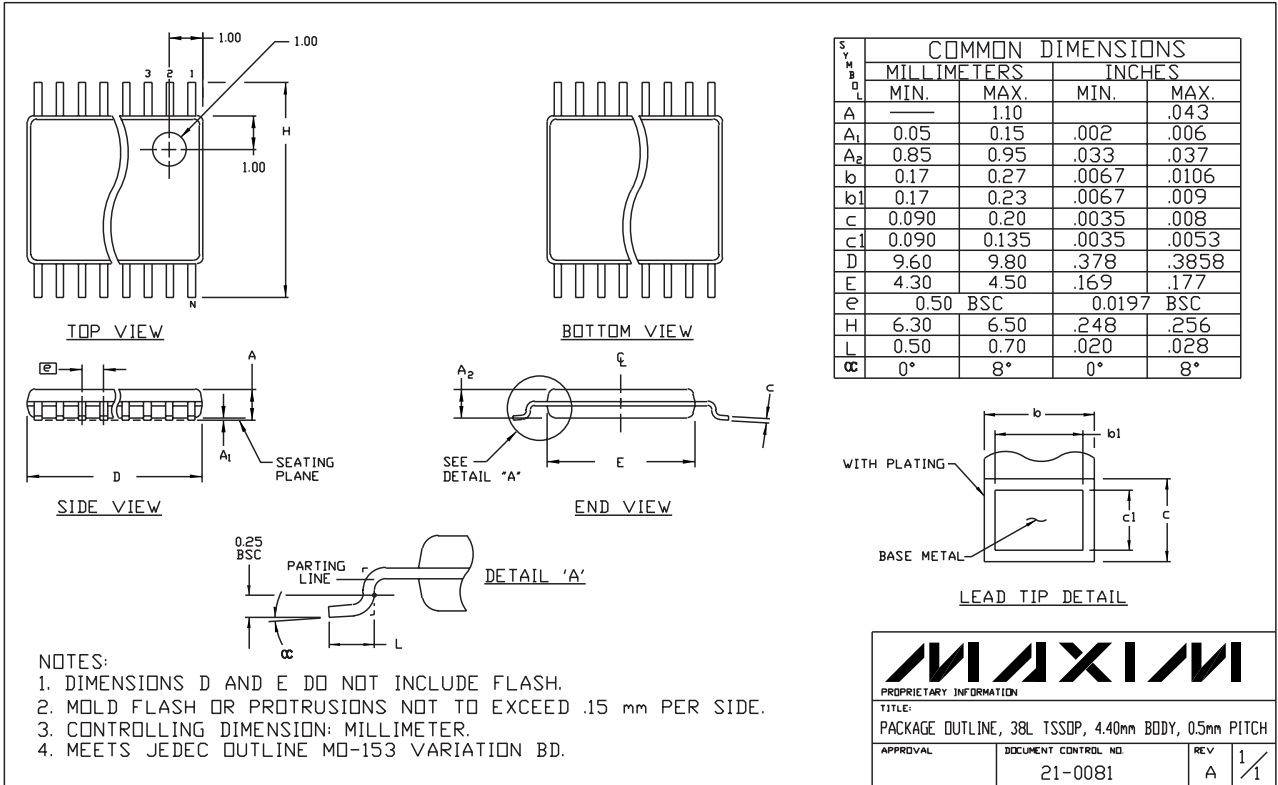


**MAX3209E**

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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).)



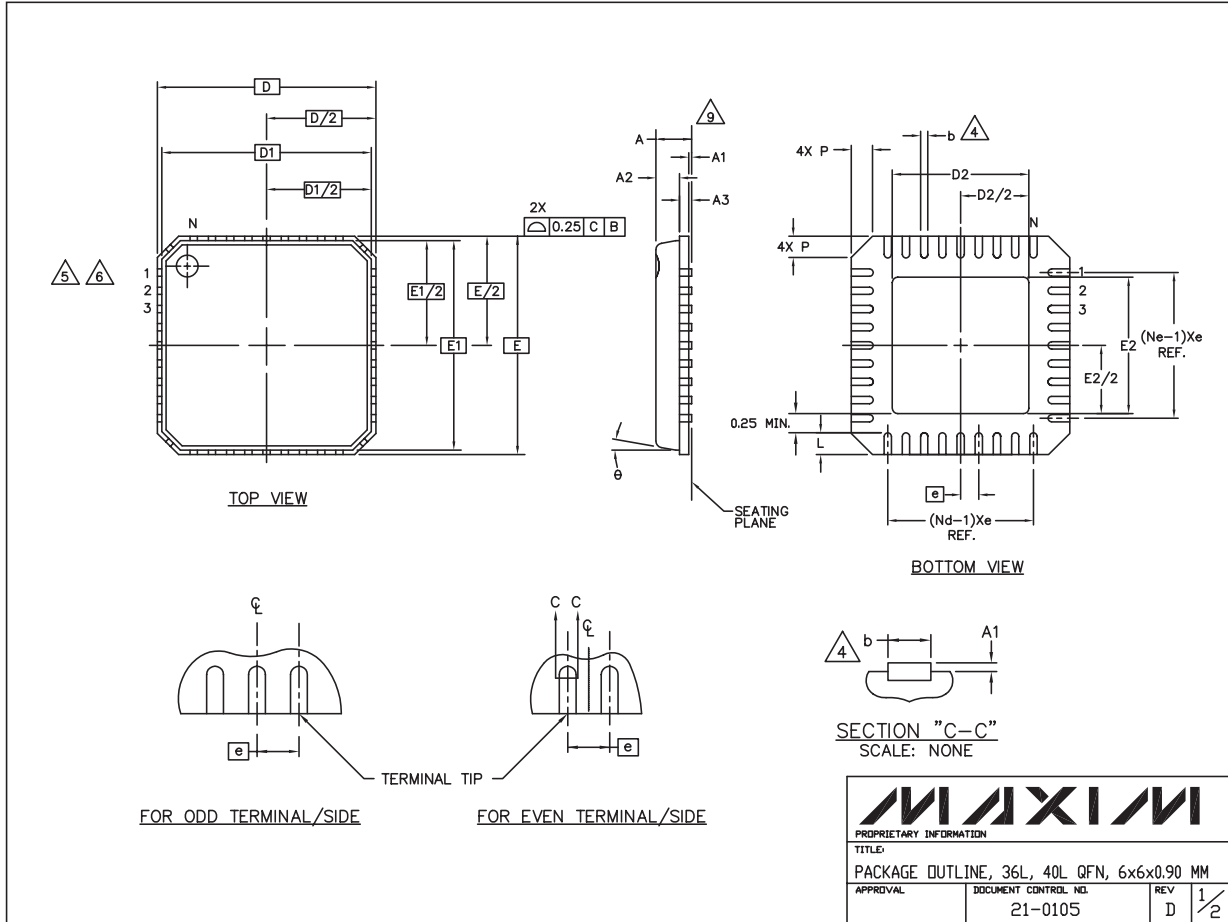
TSSOP, 4.40mm BOD, EPS

# ±15kV ESD-Protected, 12V, Dual RS-232 Serial Port with Low-Power Standby for Motherboards/Desktops

## Package Information (continued)

(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).)

**MAX3209E**



36L, 40L, QFNLEPS

<b>MAXIM</b>		
PROPRIETARY INFORMATION		
TITLE:		
PACKAGE OUTLINE, 36L, 40L QFN, 6x6x0.90 MM		
APPROVAL	DOCUMENT CONTROL NO.	REV
	21-0105	D 1/2

# ±15kV ESD-Protected, 12V, Dual RS-232 Serial Port with Low-Power Standby for Motherboards/Desktops

## Package Information (continued)

(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).)

**NOTES:**

1. DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM)
2. DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. – 1994.
3. N IS THE NUMBER OF TERMINALS.  
Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION &  
Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
5. THE PIN #1 IDENTIFIER MUST BE EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/LASER MARKED.
6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
7. ALL DIMENSIONS ARE IN MILLIMETERS.
8. PACKAGE WARPAGE MAX 0.05mm.
9. APPLIED FOR EXPOSED PAD AND TERMINALS.  
EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
10. MEETS JEDEC MO220.
11. THIS PACKAGE OUTLINE APPLIES TO ANVIL SINGULATION (STEPPED SIDES) AND TO SAW SINGULATION (STRAIGHT SIDES) QFN STYLES.

SYMBOL	COMMON DIMENSIONS			NOTE
	MIN.	NOM.	MAX.	
A	0.80	0.90	1.00	
A1	0.00	0.01	0.05	
A2	0.00	0.65	0.80	
A3	0.20 REF.			
D	6.00 BSC			
D1	5.75 BSC			
E	6.00 BSC			
E1	5.75 BSC			
θ	0°		12°	
P	0		0.60	
D2	1.75		4.25	
E2	1.75		4.25	

SYMBOL	PITCH VARIATION C						
	MIN.	NOM.	MAX.	NOTE	MIN.	NOM.	MAX.
ⓐ	0.50 BSC				0.50 BSC		
N	36			3	40		
Nd	9			3	10		
Ne	9			3	10		
L	0.50	0.60	0.75		0.30	0.40	0.50
b	0.18	0.23	0.30	4	0.18	0.23	0.30

PROPRIETARY INFORMATION		
TITLE:		
PACKAGE OUTLINE, 36L, 40L QFN, 6x6x0.90 MM		
APPROVAL	DOCUMENT CONTROL NO.	REV
	21-0105	D 2/2

Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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