



# +5V-Powered, Multichannel RS-232 Drivers/Receivers

## General Description

The MAX220–MAX249 family of line drivers/receivers is intended for all EIA/TIA-232E and V.28/V.24 communications interfaces, particularly applications where  $\pm 12V$  is not available.

These parts are especially useful in battery-powered systems, since their low-power shutdown mode reduces power dissipation to less than  $5\mu W$ . The MAX225, MAX233, MAX235, and MAX245/MAX246/MAX247 use no external components and are recommended for applications where printed circuit board space is critical.

## Applications

Portable Computers  
Low-Power Modems  
Interface Translation  
Battery-Powered RS-232 Systems  
Multidrop RS-232 Networks

## Next-Generation Device Features

- ◆ For Low-Voltage, Integrated ESD Applications  
MAX3222E/MAX3232E/MAX3237E/MAX3241E/  
MAX3246E: +3.0V to +5.5V, Low-Power, Up to 1Mbps, True RS-232 Transceivers Using Four 0.1 $\mu F$  External Capacitors (MAX3246E Available in a UCSP™ Package)
- ◆ For Low-Cost Applications  
MAX221E:  $\pm 15kV$  ESD-Protected, +5V, 1 $\mu A$ , Single RS-232 Transceiver with AutoShutdown™

## Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX220CPE	0°C to +70°C	16 Plastic DIP
MAX220CSE	0°C to +70°C	16 Narrow SO
MAX220CWE	0°C to +70°C	16 Wide SO
MAX220C/D	0°C to +70°C	Dice*
MAX220EPE	-40°C to +85°C	16 Plastic DIP
MAX220ESE	-40°C to +85°C	16 Narrow SO
MAX220EWE	-40°C to +85°C	16 Wide SO
MAX220EJE	-40°C to +85°C	16 CERDIP
MAX220MJE	-55°C to +125°C	16 CERDIP

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Ordering Information continued at end of data sheet.

\*Contact factory for dice specifications.

## Selection Table

Part Number	Power Supply (V)	No. of RS-232 Drivers/Rx	No. of Ext. Caps	Nominal Cap. Value ( $\mu F$ )	SHDN & Three-State	Rx Active in SHDN	Data Rate (kbps)	Features
MAX220	+5	2/2	4	0.047/0.33	No	—	120	Ultra-low-power, industry-standard pinout
MAX222	+5	2/2	4	0.1	Yes	—	200	Low-power shutdown
MAX223 (MAX213)	+5	4/5	4	1.0 (0.1)	Yes	✓	120	MAX241 and receivers active in shutdown
MAX225	+5	5/5	0	—	Yes	✓	120	Available in SO
MAX230 (MAX200)	+5	5/0	4	1.0 (0.1)	Yes	—	120	5 drivers with shutdown
MAX231 (MAX201)	+5 and +7.5 to +13.2	2/2	2	1.0 (0.1)	No	—	120	Standard +5/+12V or battery supplies; same functions as MAX232
MAX232 (MAX202)	+5	2/2	4	1.0 (0.1)	No	—	120 (64)	Industry standard
MAX232A	+5	2/2	4	0.1	No	—	200	Higher slew rate, small caps
MAX233 (MAX203)	+5	2/2	0	—	No	—	120	No external caps
MAX233A	+5	2/2	0	—	No	—	200	No external caps, high slew rate
MAX234 (MAX204)	+5	4/0	4	1.0 (0.1)	No	—	120	Replaces 1488
MAX235 (MAX205)	+5	5/5	0	—	Yes	—	120	No external caps
MAX236 (MAX206)	+5	4/3	4	1.0 (0.1)	Yes	—	120	Shutdown, three state
MAX237 (MAX207)	+5	5/3	4	1.0 (0.1)	No	—	120	Complements IBM PC serial port
MAX238 (MAX208)	+5	4/4	4	1.0 (0.1)	No	—	120	Replaces 1488 and 1489
MAX239 (MAX209)	+5 and +7.5 to +13.2	3/5	2	1.0 (0.1)	No	—	120	Standard +5/+12V or battery supplies; single-package solution for IBM PC serial port
MAX240	+5	5/5	4	1.0	Yes	—	120	DIP or flatpack package
MAX241 (MAX211)	+5	4/5	4	1.0 (0.1)	Yes	—	120	Complete IBM PC serial port
MAX242	+5	2/2	4	0.1	Yes	✓	200	Separate shutdown and enable
MAX243	+5	2/2	4	0.1	No	—	200	Open-line detection simplifies cabling
MAX244	+5	8/10	4	1.0	No	—	120	High slew rate
MAX245	+5	8/10	0	—	Yes	✓	120	High slew rate, int. caps, two shutdown modes
MAX246	+5	8/10	0	—	Yes	✓	120	High slew rate, int. caps, three shutdown modes
MAX247	+5	8/9	0	—	Yes	✓	120	High slew rate, int. caps, nine operating modes
MAX248	+5	8/8	4	1.0	Yes	✓	120	High slew rate, selective half-chip enables
MAX249	+5	6/10	4	1.0	Yes	✓	120	Available in quad flatpack package



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).

# +5V-Powered, Multichannel RS-232 Drivers/Receivers

## ABSOLUTE MAXIMUM RATINGS—MAX220/222/232A/233A/242/243

Supply Voltage (V <sub>CC</sub> )	-0.3V to +6V	18-Pin Plastic DIP (derate 11.1mW/°C above +70°C)	..889mW
V+ (Note 1)	(V <sub>CC</sub> - 0.3V) to +14V	20-Pin Plastic DIP (derate 8.00mW/°C above +70°C)	..440mW
V- (Note 1)	+0.3V to +14V	16-Pin Narrow SO (derate 8.70mW/°C above +70°C)	..696mW
Input Voltages		16-Pin Wide SO (derate 9.52mW/°C above +70°C)	.....762mW
T <sub>IN</sub>	-0.3V to (V <sub>CC</sub> - 0.3V)	18-Pin Wide SO (derate 9.52mW/°C above +70°C)	.....762mW
R <sub>IN</sub> (Except MAX220)	±30V	20-Pin Wide SO (derate 10.00mW/°C above +70°C)	.....800mW
R <sub>IN</sub> (MAX220)	±25V	20-Pin SSOP (derate 8.00mW/°C above +70°C)	.....640mW
T <sub>OUT</sub> (Except MAX220) (Note 2)	±15V	16-Pin CERDIP (derate 10.00mW/°C above +70°C)	.....800mW
T <sub>OUT</sub> (MAX220)	±13.2V	18-Pin CERDIP (derate 10.53mW/°C above +70°C)	.....842mW
Output Voltages		Operating Temperature Ranges	
T <sub>OUT</sub>	±15V	MAX2_AC_, MAX2_C_	.....0°C to +70°C
R <sub>OUT</sub>	-0.3V to (V <sub>CC</sub> + 0.3V)	MAX2_AE_, MAX2_E_	.....-40°C to +85°C
Driver/Receiver Output Short Circuited to GND	Continuous	MAX2_AM_, MAX2_M_	.....-55°C to +125°C
Continuous Power Dissipation (T <sub>A</sub> = +70°C)		Storage Temperature Range	.....-65°C to +160°C
16-Pin Plastic DIP (derate 10.53mW/°C above +70°C)	..842mW	Lead Temperature (soldering, 10s) (Note 3)	.....+300°C

**Note 1:** For the MAX220, V+ and V- can have a maximum magnitude of 7V, but their absolute difference cannot exceed 13V.

**Note 2:** Input voltage measured with T<sub>OUT</sub> in high-impedance state, SHDN or V<sub>CC</sub> = 0V.

**Note 3:** Maximum reflow temperature for the MAX225\_WI and MAX233A\_WP is +220°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—MAX220/222/232A/233A/242/243

(V<sub>CC</sub> = +5V ±10%, C1–C4 = 0.1µF, MAX220, C1 = 0.047µF, C2–C4 = 0.33µF, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
<b>RS-232 TRANSMITTERS</b>						
Output Voltage Swing	All transmitter outputs loaded with 3kΩ to GND		±5	±8		V
Input Logic Threshold Low				1.4	0.8	V
Input Logic Threshold High	All devices except MAX220		2	1.4		V
	MAX220: V <sub>CC</sub> = 5.0V		2.4			
Logic Pullup/Input Current	All except MAX220, normal operation			5	40	µA
	SHDN = 0V, MAX222/MAX242, shutdown, MAX220			±0.01	±1	
Output Leakage Current	V <sub>CC</sub> = 5.5V, SHDN = 0V, V <sub>OUT</sub> = ±15V, MAX222/MAX242			±0.01	±10	µA
	V <sub>CC</sub> = SHDN = 0V	V <sub>OUT</sub> = ±15V		±0.01	±10	
		MAX220, V <sub>OUT</sub> = ±12V				
Data Rate				200	116	kbps
Transmitter Output Resistance	V <sub>CC</sub> = V+ = V- = 0V, V <sub>OUT</sub> = ±2V		300	10M		Ω
Output Short-Circuit Current	V <sub>OUT</sub> = 0V	V <sub>OUT</sub> = 0V	±7	±22		mA
		MAX220			±60	
<b>RS-232 RECEIVERS</b>						
RS-232 Input Voltage Operating Range					±30	V
	MAX220				±25	
RS-232 Input Threshold Low	V <sub>CC</sub> = 5V	All except MAX243 R2 <sub>IN</sub>	0.8	1.3		V
		MAX243 R2 <sub>IN</sub> (Note 4)	-3			
RS-232 Input Threshold High	V <sub>CC</sub> = 5V	All except MAX243 R2 <sub>IN</sub>		1.8	2.4	V
		MAX243 R2 <sub>IN</sub> (Note 4)		-0.5	-0.1	

# +5V-Powered, Multichannel RS-232 Drivers/Receivers

MAX220-MAX249

## ELECTRICAL CHARACTERISTICS—MAX220/222/232A/233A/242/243 (continued)

(V<sub>CC</sub> = +5V ±10%, C1–C4 = 0.1µF, MAX220, C1 = 0.047µF, C2–C4 = 0.33µF, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
RS-232 Input Hysteresis	All except MAX220/MAX243, V <sub>CC</sub> = 5V, no hysteresis in SHDN		0.2	0.5	1	V
	MAX220		0.3			
	MAX243		1			
RS-232 Input Resistance	T <sub>A</sub> = +25°C (MAX220)		3	5	7	kΩ
			3	5	7	
TTL/CMOS Output Voltage Low	I <sub>OUT</sub> = 3.2mA		0.2		0.4	V
	I <sub>OUT</sub> = 1.6mA (MAX220)		0.4			
TTL/CMOS Output Voltage High	I <sub>OUT</sub> = -1.0mA		3.5	V <sub>CC</sub> - 0.2		V
TTL/CMOS Output Short-Circuit Current	Sourcing V <sub>OUT</sub> = GND		-2	-10		mA
	Sinking V <sub>OUT</sub> = V <sub>CC</sub>		10	30		
TTL/CMOS Output Leakage Current	SHDN = V <sub>CC</sub> or EN = V <sub>CC</sub> (SHDN = 0V for MAX222), 0V ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub>		±0.05		±10	µA
EN Input Threshold Low	MAX242		1.4		0.8	V
EN Input Threshold High	MAX242		2.0	1.4		V
Operating Supply Voltage			4.5		5.5	V
V <sub>CC</sub> Supply Current (SHDN = V <sub>CC</sub> ), figures 5, 6, 11, 19	No load	MAX220	0.5		2	µA
		MAX222/MAX232A/MAX233A/MAX242/MAX243	4		10	
	3kΩ load both inputs	MAX220	12			
		MAX222/MAX232A/MAX233A/MAX242/MAX243	15			
Shutdown Supply Current	MAX222/MAX242	T <sub>A</sub> = +25°C	0.1		10	µA
		T <sub>A</sub> = 0°C to +70°C	2		50	
		T <sub>A</sub> = -40°C to +85°C	2		50	
		T <sub>A</sub> = -55°C to +125°C	35		100	
SHDN Input Leakage Current	MAX222/MAX242				±1	µA
SHDN Threshold Low	MAX222/MAX242		1.4		0.8	V
SHDN Threshold High	MAX222/MAX242		2.0	1.4		V
Transition Slew Rate	C <sub>L</sub> = 50pF to 2500pF, R <sub>L</sub> = 3kΩ to 7kΩ, V <sub>CC</sub> = 5V, T <sub>A</sub> = +25°C, measured from +3V to -3V or -3V	MAX222/MAX232A/MAX233/MAX242/MAX243	6	12	30	V/µs
		MAX220	1.5	3	30	
Transmitter Propagation Delay TLL to RS-232 (Normal Operation), Figure 1	t <sub>PHLT</sub>	MAX222/MAX232A/MAX233/MAX242/MAX243	1.3		3.5	µs
		MAX220	4		10	
	t <sub>PLHT</sub>	MAX222/MAX232A/MAX233/MAX242/MAX243	1.5		3.5	
		MAX220	5		10	

**Note 4:** MAX243 R<sub>2OUT</sub> is guaranteed to be low when R<sub>2IN</sub> is ≥ 0V or is floating.

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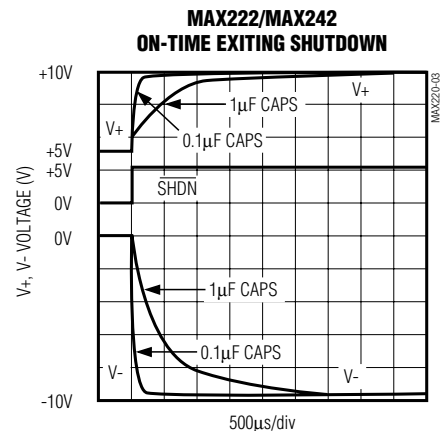
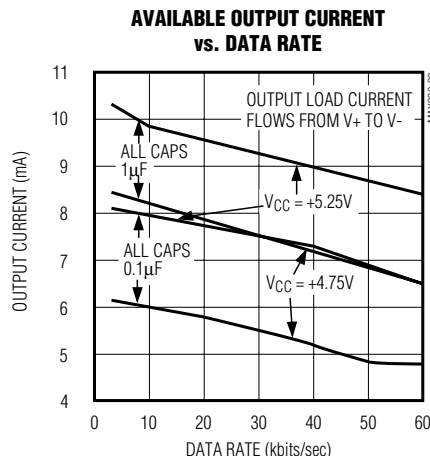
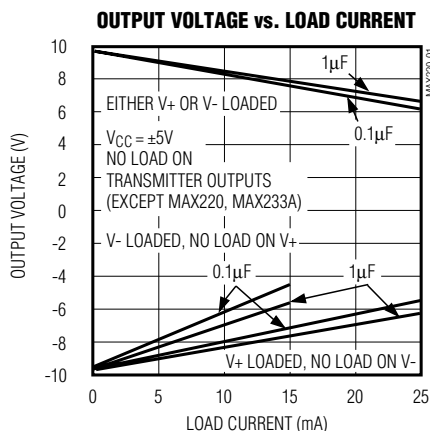
## ELECTRICAL CHARACTERISTICS—MAX220/222/232A/233A/242/243 (continued)

(V<sub>CC</sub> = +5V ±10%, C<sub>1</sub>–C<sub>4</sub> = 0.1μF, MAX220, C<sub>1</sub> = 0.047μF, C<sub>2</sub>–C<sub>4</sub> = 0.33μF, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Receiver Propagation Delay RS-232 to TLL (Normal Operation), Figure 2	t <sub>PHLR</sub>	MAX222/MAX232A/MAX233/ MAX242/MAX243		0.5	1	μs
		MAX220		0.6	3	
	t <sub>PLHR</sub>	MAX222/MAX232A/MAX233/ MAX242/MAX243		0.6	1	
		MAX220		0.8	3	
Receiver Propagation Delay RS-232 to TLL (Shutdown), Figure 2	t <sub>PHLS</sub>	MAX242		0.5	10	μs
	t <sub>PHLS</sub>	MAX242		2.5	10	
Receiver-Output Enable Time, Figure 3	t <sub>ER</sub>	MAX242		125	500	ns
Receiver-Output Disable Time, Figure 3	t <sub>DR</sub>	MAX242		160	500	ns
Transmitter-Output Enable Time ( $\overline{\text{SHDN}}$ Goes High), Figure 4	t <sub>ET</sub>	MAX222/MAX242, 0.1μF caps (includes charge-pump start-up)		250		μs
Transmitter-Output Disable Time ( $\overline{\text{SHDN}}$ Goes Low), Figure 4	t <sub>DT</sub>	MAX222/MAX242, 0.1μF caps		600		ns
Transmitter + to - Propagation Delay Difference (Normal Operation)	t <sub>PHLT</sub> - t <sub>PLHT</sub>	MAX222/MAX232A/MAX233/ MAX242/MAX243		300		ns
		MAX220		2000		
Receiver + to - Propagation Delay Difference (Normal Operation)	t <sub>PHLR</sub> - t <sub>PLHR</sub>	MAX222/MAX232A/MAX233/ MAX242/MAX243		100		ns
		MAX220		225		

### Typical Operating Characteristics

#### MAX220/MAX222/MAX232A/MAX233A/MAX242/MAX243



# +5V-Powered, Multichannel RS-232 Drivers/Receivers

## Ordering Information (continued)

**MAX220-MAX249**

PART	TEMP RANGE	PIN-PACKAGE
MAX222CPN	0°C to +70°C	18 Plastic DIP
MAX222CWN	0°C to +70°C	18 Wide SO
MAX222C/D	0°C to +70°C	Dice*
MAX222EPN	-40°C to +85°C	18 Plastic DIP
MAX222EWN	-40°C to +85°C	18 Wide SO
MAX222EJN	-40°C to +85°C	18 CERDIP
MAX222MJN	-55°C to +125°C	18 CERDIP
MAX223CAI	0°C to +70°C	28 SSOP
MAX223CWI	0°C to +70°C	28 Wide SO
MAX223C/D	0°C to +70°C	Dice*
MAX223EAI	-40°C to +85°C	28 SSOP
MAX223EWI	-40°C to +85°C	28 Wide SO
MAX225CWI	0°C to +70°C	28 Wide SO
MAX225EWI	-40°C to +85°C	28 Wide SO
MAX230CPP	0°C to +70°C	20 Plastic DIP
MAX230CWP	0°C to +70°C	20 Wide SO
MAX230C/D	0°C to +70°C	Dice*
MAX230EPP	-40°C to +85°C	20 Plastic DIP
MAX230EWP	-40°C to +85°C	20 Wide SO
MAX230EJP	-40°C to +85°C	20 CERDIP
MAX230MJP	-55°C to +125°C	20 CERDIP
MAX231CPD	0°C to +70°C	14 Plastic DIP
MAX231CWE	0°C to +70°C	16 Wide SO
MAX231CJD	0°C to +70°C	14 CERDIP
MAX231C/D	0°C to +70°C	Dice*
MAX231EPD	-40°C to +85°C	14 Plastic DIP
MAX231EWE	-40°C to +85°C	16 Wide SO
MAX231EJD	-40°C to +85°C	14 CERDIP
MAX231MJD	-55°C to +125°C	14 CERDIP
MAX232CPE	0°C to +70°C	16 Plastic DIP
MAX232CSE	0°C to +70°C	16 Narrow SO
MAX232CWE	0°C to +70°C	16 Wide SO
MAX232C/D	0°C to +70°C	Dice*
MAX232EPE	-40°C to +85°C	16 Plastic DIP
MAX232ESE	-40°C to +85°C	16 Narrow SO
MAX232EWE	-40°C to +85°C	16 Wide SO
MAX232EJE	-40°C to +85°C	16 CERDIP
MAX232MJE	-55°C to +125°C	16 CERDIP
MAX232MLP	-55°C to +125°C	20 LCC
MAX232ACPE	0°C to +70°C	16 Plastic DIP
MAX232ACSE	0°C to +70°C	16 Narrow SO
MAX232ACWE	0°C to +70°C	16 Wide SO

PART	TEMP RANGE	PIN-PACKAGE
MAX232AC/D	0°C to +70°C	Dice*
MAX232AEPE	-40°C to +85°C	16 Plastic DIP
MAX232AESE	-40°C to +85°C	16 Narrow SO
MAX232AEWE	-40°C to +85°C	16 Wide SO
MAX232AEJE	-40°C to +85°C	16 CERDIP
MAX232AMJE	-55°C to +125°C	16 CERDIP
MAX232AML	-55°C to +125°C	20 LCC
MAX233CPP	0°C to +70°C	20 Plastic DIP
MAX233EPP	-40°C to +85°C	20 Plastic DIP
MAX233ACPP	0°C to +70°C	20 Plastic DIP
MAX233ACWP	0°C to +70°C	20 Wide SO
MAX233AEPP	-40°C to +85°C	20 Plastic DIP
MAX233AERP	-40°C to +85°C	20 Wide SO
MAX234CPE	0°C to +70°C	16 Plastic DIP
MAX234CWE	0°C to +70°C	16 Wide SO
MAX234C/D	0°C to +70°C	Dice*
MAX234EPE	-40°C to +85°C	16 Plastic DIP
MAX234EWE	-40°C to +85°C	16 Wide SO
MAX234EJE	-40°C to +85°C	16 CERDIP
MAX234MJE	-55°C to +125°C	16 CERDIP
MAX235CPG	0°C to +70°C	24 Wide Plastic DIP
MAX235EPG	-40°C to +85°C	24 Wide Plastic DIP
MAX235EDG	-40°C to +85°C	24 Ceramic SB
MAX235MDG	-55°C to +125°C	24 Ceramic SB
MAX236CNG	0°C to +70°C	24 Narrow Plastic DIP
MAX236CWG	0°C to +70°C	24 Wide SO
MAX236C/D	0°C to +70°C	Dice*
MAX236ENG	-40°C to +85°C	24 Narrow Plastic DIP
MAX236EWG	-40°C to +85°C	24 Wide SO
MAX236ERG	-40°C to +85°C	24 Narrow CERDIP
MAX236MRG	-55°C to +125°C	24 Narrow CERDIP
MAX237CNG	0°C to +70°C	24 Narrow Plastic DIP
MAX237CWG	0°C to +70°C	24 Wide SO
MAX237C/D	0°C to +70°C	Dice*
MAX237ENG	-40°C to +85°C	24 Narrow Plastic DIP
MAX237EWG	-40°C to +85°C	24 Wide SO
MAX237ERG	-40°C to +85°C	24 Narrow CERDIP
MAX237MRG	-55°C to +125°C	24 Narrow CERDIP
MAX238CNG	0°C to +70°C	24 Narrow Plastic DIP
MAX238CWG	0°C to +70°C	24 Wide SO
MAX238C/D	0°C to +70°C	Dice*
MAX238ENG	-40°C to +85°C	24 Narrow Plastic DIP

\* Contact factory for dice specifications.