MAXIM

3.0V to 5.5V, Low-Power, up to 1Mbps, True RS-232 Transceivers Using Four 0.1µF External Capacitors

_____General Description

The MAX3222/MAX3232/MAX3237/MAX3241 transceivers have a proprietary low-dropout transmitter output stage enabling true RS-232 performance from a 3.0V to 5.5V supply with a dual charge pump. The devices require only four small 0.1µF external charge-pump capacitors. The MAX3222, MAX3232, and MAX3241 are guaranteed to run at data rates of 120kbps while maintaining RS-232 output levels. The MAX3237 is guaranteed to run at data rates of 250kbps in the normal operating mode and 1Mbps in the MegaBaud™ operating mode, while maintaining RS-232 output levels.

The MAX3222/MAX3232 have 2 receivers and 2 drivers. The MAX3222 features a 1µA shutdown mode that reduces power consumption and extends battery life in portable systems. Its receivers remain active in shutdown mode, allowing external devices such as modems to be monitored using only 1µA supply current. The MAX3222 and MAX3232 are pin, package, and functionally compatible with the industry-standard MAX242 and MAX232, respectively.

The MAX3241 is a complete serial port (3 drivers/ 5 receivers) designed for notebook and subnotebook computers. The MAX3237 (5 drivers/3 receivers) is ideal for fast modem applications. Both these devices feature a shutdown mode in which all receivers can remain active while using only 1µA supply current. Receivers R1 (MAX3237/MAX3241) and R2 (MAX3241) have extra outputs in addition to their standard outputs. These extra outputs are always active, allowing external devices such as a modem to be monitored without forward biasing the protection diodes in circuitry that may have V_{CC} completely removed.

The MAX3222, MAX3237, and MAX3241 are available in space-saving SSOP packages.

_____Applications

Notebook, Subnotebook, and Palmtop Computers

High-Speed Modems

Battery-Powered Equipment

Hand-Held Equipment

Peripherals

Printers

Typical Operating Circuits appear at end of data sheet.

_____Features
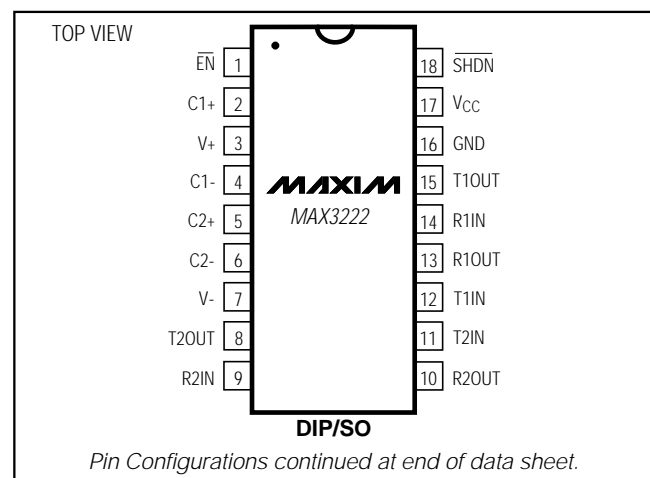
♦ **Low Supply Current:**
  300µA (MAX3222/MAX3232/MAX3241)
  500µA (MAX3237)

♦ **Guaranteed Data Rate:**
  120kbps (MAX3222/MAX3232/MAX3241)
  250kbps (MAX3237—Normal Operation)
  1Mbps (MAX3237—MegaBaud Operation)

♦ **1µA Low-Power Shutdown with Receivers Active (MAX3222/MAX3237/MAX3241)**

♦ **Flow-Through Pinout (MAX3237)**

♦ **Meets EIA/TIA-232 Specifications Down to 3.0V**

♦ **Guaranteed Mouse Driveability (MAX3241)**

♦ **Pin Compatible with Industry-Standard MAX232 (MAX3232)**
  Pin Compatible with Industry-Standard MAX242 (MAX3222)

♦ **Guaranteed Slew Rate:**
  6V/µs (MAX3222/MAX3232/MAX3237/MAX3241)
  24V/µs (MAX3237—MegaBaud Operation)

_____Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX3222CPN	0°C to +70°C	18 Plastic DIP
MAX3222CWN	0°C to +70°C	18 SO
MAX3222CAP	0°C to +70°C	20 SSOP

Ordering Information continued at end of data sheet.

_____Pin Configurations

TOP VIEW

```
        ┌─────────┐
   EN  1│•        │18  SHDN
   C1+ 2│         │17  VCC
   V+  3│         │16  GND
   C1- 4│  MAXIM  │15  T1OUT
   C2+ 5│ MAX3222 │14  R1IN
   C2- 6│         │13  R1OUT
   V-  7│         │12  T1IN
 T2OUT 8│         │11  T2IN
  R2IN 9│         │10  R2OUT
        └─────────┘
```

DIP/SO

Pin Configurations continued at end of data sheet.

MegaBaud is a trademark of Maxim Integrated Products.
*Covered by U.S. Patent numbers 4,636,930; 4,679,134; 4,777,577; 4,797,899; 4,809,152; 4,897,774; 4,999,761; and other patents pending.

MAXIM _____ **Maxim Integrated Products 1**

For free samples & the latest literature: http://www.maxim-ic.com, or phone 1-800-998-8800

3.0V to 5.5V, Low-Power, up to 1Mbps, True RS-232 Transceivers Using Four 0.1µF External Capacitors

ABSOLUTE MAXIMUM RATINGS

V$_{CC}$..-0.3V to +6V
V+ (Note 1) ....-0.3V to +7V
V- (Note 1) ....+0.3V to -7V
V+ + V- (Note 1)..+13V
Input Voltages
    T_IN, $\overline{\text{SHDN}}$, $\overline{\text{EN}}$ ....-0.3V to +6V
    MBAUD...-0.3V to (V$_{CC}$ + 0.3V)
    R_IN ....±25V
Output Voltages
    T_OUT...±13.2V
    R_OUT ....-0.3V to (V$_{CC}$ + 0.3V)
Short-Circuit Duration
    T_OUT ....Continuous

Continuous Power Dissipation (T$_A$ = +70°C)
    16-Pin Plastic DIP (derate 10.53mW/°C above +70°C)...842mW
    16-Pin Narrow SO (derate 8.70mW/°C above +70°C) 696mW
    16-Pin Wide SO (derate 9.52mW/°C above +70°C)........762mW
    18-Pin Plastic DIP (derate 11.11mW/°C above +70°C) ..889mW
    18-Pin SO (derate 9.52mW/°C above +70°C).............762mW
    20-Pin SSOP (derate 8.00mW/°C above +70°C) 640mW
    28-Pin SO (derate 12.50mW/°C above +70°C)...................1W
    28-Pin SSOP (derate 9.52mW/°C above +70°C) 762mW
Operating Temperature Ranges
    MAX32_ _C_ _...0°C to +70°C
    MAX32_ _E_ _ ....-40°C to +85°C
Storage Temperature Range ....-65°C to +150°C
Lead Temperature (soldering, 10sec) ....+300°C

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

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$_{CC}$ = +3.0V to +5.5V, C1–C4 = 0.1µF (Note 2), T$_A$ = T$_{MIN}$ to T$_{MAX}$, unless otherwise noted. Typical values are at T$_A$ = +25°C.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
DC CHARACTERISTICS						
V$_{CC}$ Power-Supply Current	No load, V$_{CC}$ = 3.3V or 5.0V, T$_A$ = +25°C	MAX3222/MAX3232/ MAX3241		0.3	1.0	mA
		MAX3237		0.5	2.0	
Shutdown Supply Current	SHDN = GND, T$_A$ = +25°C			1.0	10	µA
LOGIC INPUTS AND RECEIVER OUTPUTS						
Input Logic Threshold Low (Note 3)	T_IN, $\overline{\text{EN}}$, $\overline{\text{SHDN}}$, MBAUD				0.8	V
Input Logic Threshold High (Note 3)	V$_{CC}$ = 3.3V		2.0			V
	V$_{CC}$ = 5.0V		2.4			
Input Leakage Current	T_IN, $\overline{\text{EN}}$, $\overline{\text{SHDN}}$, MBAUD			±0.01	±1.0	µA
Output Leakage Current	Receivers disabled			±0.05	±10	µA
Output Voltage Low	I$_{OUT}$ = 1.6mA				0.4	V
Output Voltage High	I$_{OUT}$ = -1.0mA		V$_{CC}$ - 0.6	V$_{CC}$ - 0.1		V
RECEIVER INPUTS						
Input Voltage Range			-25		25	V
Input Threshold Low	V$_{CC}$ = 3.3V		0.6	1.2		V
	V$_{CC}$ = 5.0V		0.8	1.5		
Input Threshold High	V$_{CC}$ = 3.3V			1.5	2.4	V
	V$_{CC}$ = 5.0V			1.8	2.4	
Input Hysteresis				0.3		V
Input Resistance	T$_A$ = +25°C		3	5	7	kΩ

MAXIM

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +3.0V to +5.5V, C1–C4 = 0.1µF (Note 2), T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
TRANSMITTER OUTPUTS					
Output Voltage Swing	All transmitter outputs loaded with 3kΩ to ground	±5.0	±5.4		V
Output Resistance	V_{CC} = V+ = V- = 0V, T_{OUT} = 2V	300	10M		Ω
Output Short-Circuit Current			±35	±60	mA
Output Leakage Current	V_{OUT} = 12V, V_{CC} = 0V to 5.5V, transmitters disabled			±25	µA
MOUSE DRIVEABILITY (MAX3241)					
Transmitter Output Voltage	T1IN = T2IN = GND, T3IN = V_{CC}, T3OUT loaded with 3kΩ to GND, T1OUT and T2OUT loaded with 2.5mA each	±5.0			V

TIMING CHARACTERISTICS—MAX3222/MAX3232/MAX3241

(V_{CC} = +3.0V to +5.5V, C1–C4 = 0.1µF (Note 2), T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)
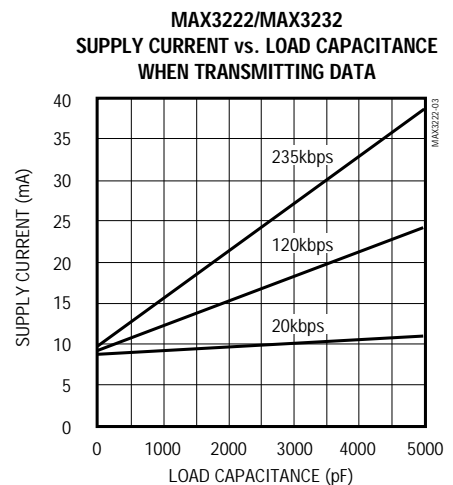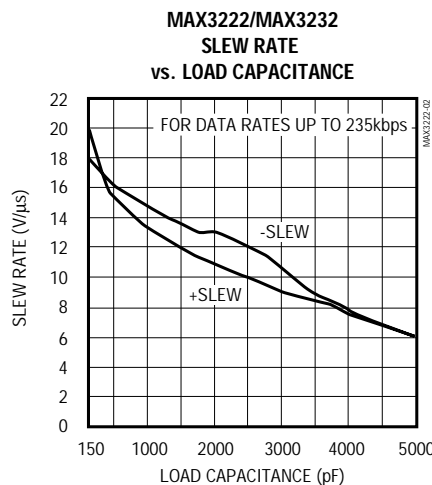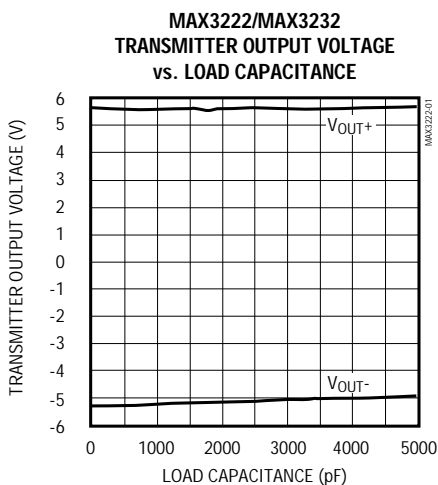
PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Maximum Data Rate	R_L = 3kΩ, C_L = 1000pF, one transmitter switching		120	235		kbps
Receiver Propagation Delay	R_IN to R_OUT, C_L = 150pF	t_{PHL}		0.3		µs
		t_{PLH}		0.3		
Receiver Output Enable Time	Normal operation			200		ns
Receiver Output Disable Time	Normal operation			200		ns
Transmitter Skew	$\mid t_{PHL} - t_{PLH} \mid$			300		ns
Receiver Skew	$\mid t_{PHL} - t_{PLH} \mid$			300		ns
Transition-Region Slew Rate	V_{CC} = 3.3V, R_L = 3Ω to 7kΩ, +3V to -3V or -3V to +3V, T_A = +25°C	C_L = 150pF to 1000pF	6		30	V/µs
		C_L = 150pF to 2500pF	4		30	

3.0V to 5.5V, Low-Power, up to 1Mbps, True RS-232 Transceivers Using Four 0.1µF External Capacitors

TIMING CHARACTERISTICS—MAX3237

(V_{CC} = +3.0V to +5.5V, C1–C4 = 0.1µF (Note 2), T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
Maximum Data Rate	R_L = 3kΩ, C_L = 1000pF, one transmitter switching, MBAUD = GND			250			kbps
	V_{CC} = 3.0V to 4.5V, R_L = 3kΩ, C_L = 250pF, one transmitter switching, MBAUD = V_{CC}			1000			
	V_{CC} = 4.5V to 5.5V, R_L = 3kΩ, C_L = 1000pF, one transmitter switching, MBAUD = V_{CC}			1000			
Receiver Propagation Delay	R_IN to R_OUT, C_L = 150pF	t_{PHL}			0.15		µs
		t_{PLH}			0.15		
Receiver Output Enable Time	Normal operation				200		ns
Receiver Output Disable Time	Normal operation				200		ns
Transmitter Skew	$\mid t_{PHL} - t_{PLH} \mid$, MBAUD = GND				100		ns
	$\mid t_{PHL} - t_{PLH} \mid$, MBAUD = V_{CC}				25		ns
Receiver Skew	$\mid t_{PHL} - t_{PLH} \mid$				50		ns
Transition-Region Slew Rate	V_{CC} = 3.3V, R_L = 3Ω to 7kΩ, +3V to -3V or -3V to +3V, T_A = +25°C	C_L = 150pF to 1000pF	MBAUD = GND	6		30	V/µs
			MBAUD = V_{CC}	24		150	
		C_L = 150pF to 2500pF, MBAUD = GND		4		30	

Note 2: MAX3222/MAX3232/MAX3241: C1–C4 = 0.1µF tested at 3.3V ±10%; C1 = 0.047µF, C2–C4 = 0.33µF tested at 5.0V ±10%. MAX3237: C1–C4 = 0.1µF tested at 3.3V ±5%; C1–C4 = 0.22µF tested at 3.3V ±10%; C1 = 0.047µF, C2–C4 = 0.33µF tested at 5.0V ±10%.

Note 3: Transmitter input hysteresis is typically 250mV.
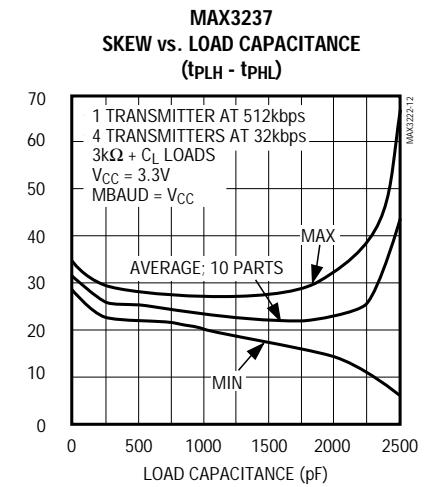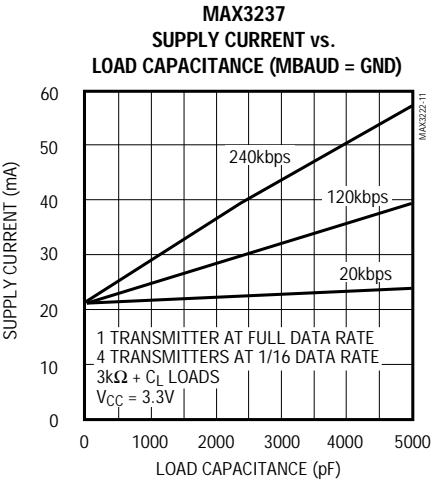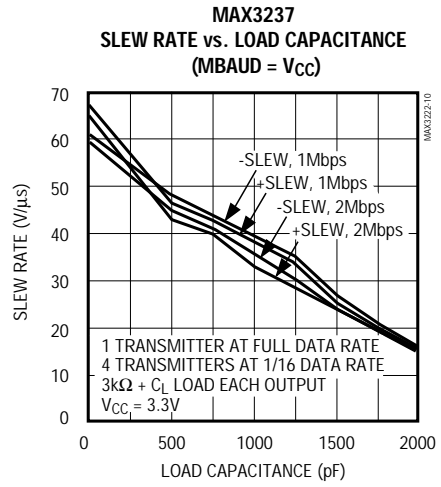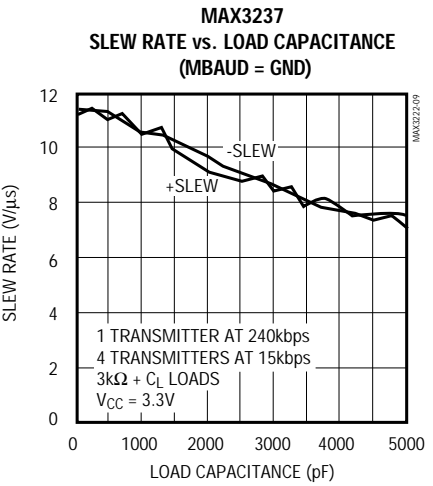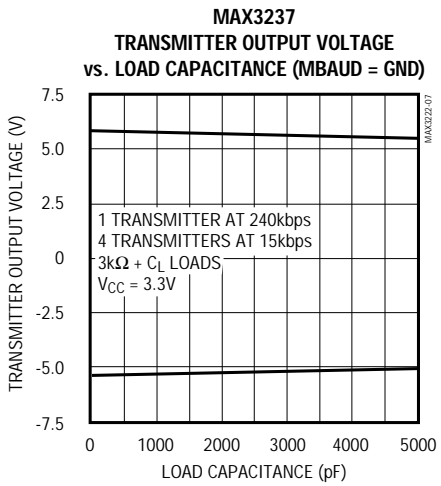
Typical Operating Characteristics
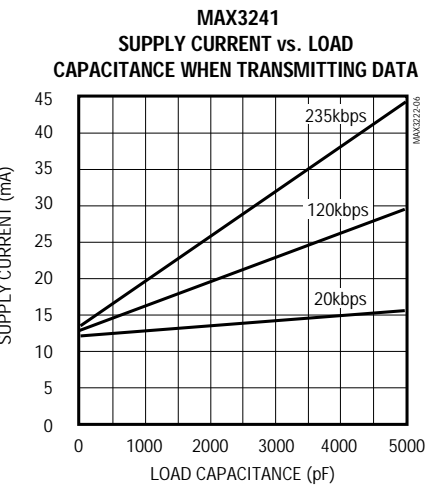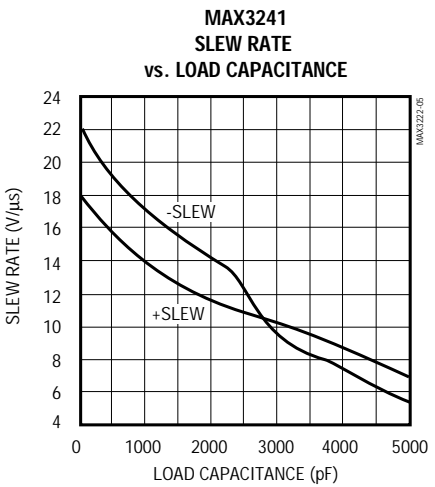
(V_{CC} = +3.3V, 235kbps data rate, 0.1µF capacitors, all transmitters loaded with 3kΩ, T_A = +25°C, unless otherwise noted.)

MAX3222/MAX3232
TRANSMITTER OUTPUT VOLTAGE
vs. LOAD CAPACITANCE

MAX3222/MAX3232
SLEW RATE
vs. LOAD CAPACITANCE

MAX3222/MAX3232
SUPPLY CURRENT vs. LOAD CAPACITANCE
WHEN TRANSMITTING DATA

MAXIM

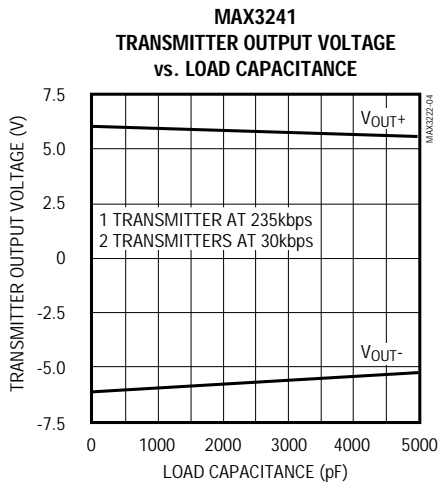# 3.0V to 5.5V, Low-Power, up to 1Mbps, True RS-232 Transceivers Using Four 0.1μF External Capacitors

(V_{CC} = +3.3V, 235kbps data rate, 0.1μF capacitors, all transmitters loaded with 3kΩ, T_A = +25°C, unless otherwise noted.)

MAX3241
TRANSMITTER OUTPUT VOLTAGE
vs. LOAD CAPACITANCE

MAX3241
SLEW RATE
vs. LOAD CAPACITANCE

MAX3241
SUPPLY CURRENT vs. LOAD
CAPACITANCE WHEN TRANSMITTING DATA

MAX3237
TRANSMITTER OUTPUT VOLTAGE
vs. LOAD CAPACITANCE (MBAUD = GND)

MAX3237
TRANSMITTER OUTPUT VOLTAGE
vs. LOAD CAPACITANCE (MBAUD = V_{CC})

MAX3237
SLEW RATE vs. LOAD CAPACITANCE
(MBAUD = GND)

MAX3237
SLEW RATE vs. LOAD CAPACITANCE
(MBAUD = V_{CC})

MAX3237
SUPPLY CURRENT vs.
LOAD CAPACITANCE (MBAUD = GND)

MAX3237
SKEW vs. LOAD CAPACITANCE
(t_{PLH} - t_{PHL})

MAX3222/MAX3232/MAX3237/MAX3241

_____ 5

3.0V to 5.5V, Low-Power, up to 1Mbps, True RS-232 Transceivers Using Four 0.1µF External Capacitors

_____Pin Description

PIN					NAME	FUNCTION
MAX3222		MAX3232	MAX3237	MAX3241		
DIP/SO	SSOP					
1	1	—	13	23	$\overline{EN}$	Receiver Enable. Active low.
2	2	1	28	28	C1+	Positive Terminal of Voltage-Doubler Charge-Pump Capacitor
3	3	2	27	27	V+	+5.5V Generated by the Charge Pump
4	4	3	25	24	C1-	Negative Terminal of Voltage-Doubler Charge-Pump Capacitor
5	5	4	1	1	C2+	Positive Terminal of Inverting Charge-Pump Capacitor
6	6	5	3	2	C2-	Negative Terminal of Inverting Charge-Pump Capacitor
7	7	6	4	3	V-	-5.5V Generated by the Charge Pump
8, 15	8, 17	7, 14	5, 6, 7, 10, 12	9, 10, 11	T_OUT	RS-232 Transmitter Outputs
9, 14	9, 16	8, 13	8, 9, 11	4–8	R_IN	RS-232 Receiver Inputs
10, 13	10, 15	9, 12	18, 20, 21	15–19	R_OUT	TTL/CMOS Receiver Outputs
11, 12	12, 13	10, 11	17, 19, 22, 23, 24	12, 13, 14	T_IN	TTL/CMOS Transmitter Inputs
16	18	15	2	25	GND	Ground
17	19	16	26	26	V_{CC}	+3.0V to +5.5V Supply Voltage
18	20	—	14	22	$\overline{SHDN}$	Shutdown Control. Active low.
—	11, 14	—	—	—	N.C.	No Connection
—	—	—	15	—	MBAUD	MegaBaud Control Input. Connect to GND for normal operation; connect to V_{CC} for 1Mbps transmission rates.
—	—	—	16	20, 21	R_OUTB	Noninverting Complementary Receiver Outputs. Always active.

MAXIM

3.0V to 5.5V, Low-Power, up to 1Mbps, True RS-232 Transceivers Using Four 0.1µF External Capacitors

_____Detailed Description

Dual Charge-Pump Voltage Converter
The MAX3222/MAX3232/MAX3237/MAX3241's internal power supply consists of a regulated dual charge pump that provides output voltages of +5.5V (doubling charge pump) and -5.5V (inverting charge pump), regardless of the input voltage (V_{CC}) over the 3.0V to 5.5V range. The charge pumps operate in a discontinuous mode; if the output voltages are less than 5.5V, the charge pumps are enabled, and if the output voltages exceed 5.5V, the charge pumps are disabled. Each charge pump requires a flying capacitor (C1, C2) and a reservoir capacitor (C3, C4) to generate the V+ and V- supplies.

RS-232 Transmitters
The transmitters are inverting level translators that convert CMOS-logic levels to 5.0V EIA/TIA-232 levels.

The MAX3222/MAX3232/MAX3241 transmitters guarantee a 120kbps data rate with worst-case loads of 3kΩ in parallel with 1000pF, providing compatibility with PC-to-PC communication software (such as LapLink™). Typically, these three devices can operate at data rates of 235kbps. Transmitters can be paralleled to drive multiple receivers or mice.

LapLink is a trademark of Traveling Software.

The MAX3222/MAX3237/MAX3241's output stage is turned off (high impedance) when the device is in shutdown mode. When the power is off, the MAX3222/MAX3232/MAX3237/MAX3241 permit the outputs to be driven up to ±12V.

The transmitter inputs do not have pull-up resistors. Connect unused inputs to GND or V_{CC}.

MAX3237 MegaBaud Operation
In normal operating mode (MBAUD = GND), the MAX3237 transmitters guarantee a 250kbps data rate with worst-case loads of 3kΩ in parallel with 1000pF. This provides compatibility with PC-to-PC communication software, such as Laplink™.

For higher speed serial communications, the MAX3237 features MegaBaud operation. In MegaBaud operating mode (MBAUD = V_{CC}), the MAX3237 transmitters guarantee a 1Mbps data rate with worst-case loads of 3kΩ in parallel with 250pF for 3.0V < V_{CC} < 4.5V. For 5V ±10% operation, the MAX3237 transmitters guarantee a 1Mbps data rate into worst-case loads of 3kΩ in parallel with 1000pF.
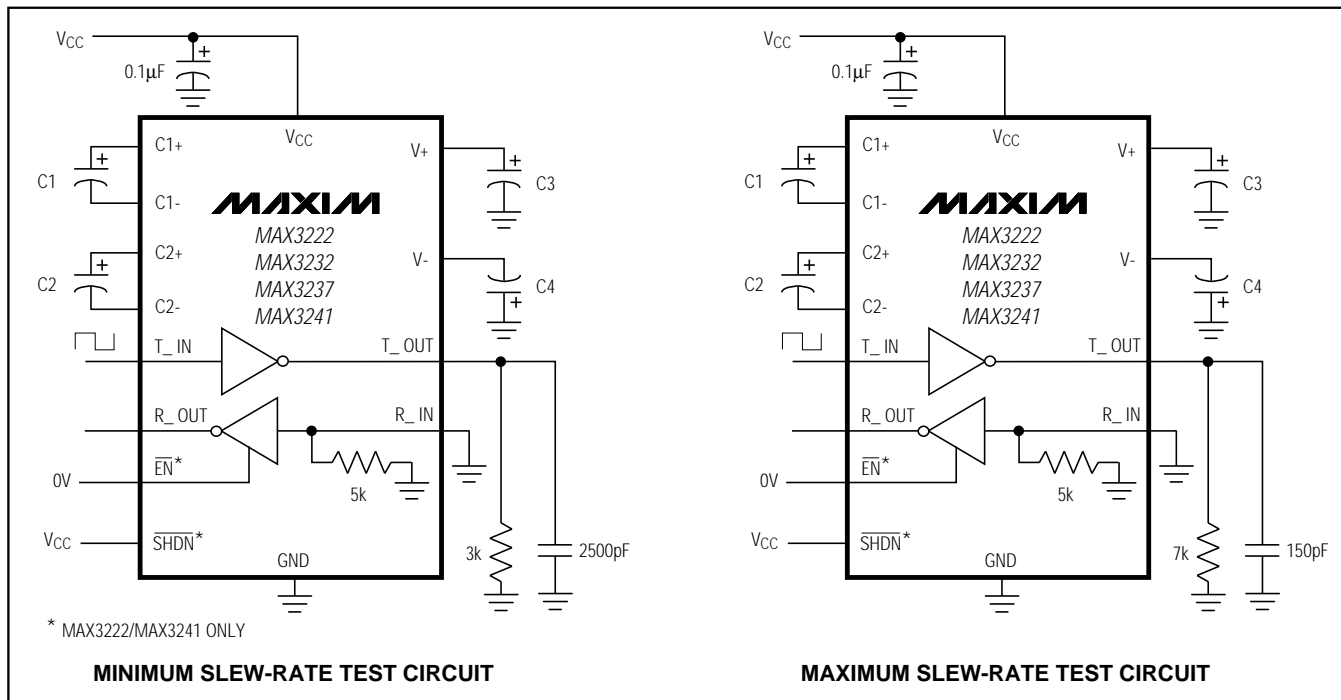

Figure 1. Slew-Rate Test Circuits
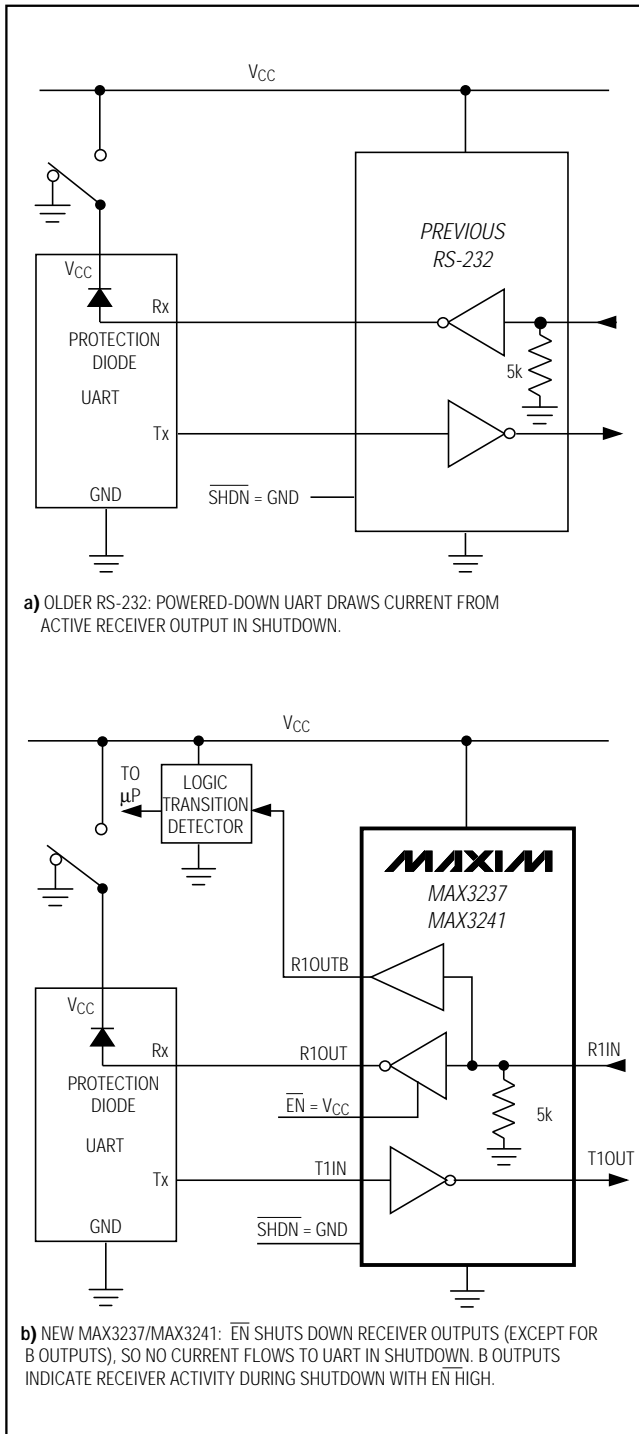
RS-232 Receivers

The receivers convert RS-232 signals to CMOS-logic output levels. The MAX3222/MAX3237/MAX3241 receivers have inverting three-state outputs. In shutdown, the receivers can be active or inactive (Table 1).

The complementary outputs on the MAX3237 (R1OUTB) and the MAX3241 (R1OUTB, R2OUTB) are always active, regardless of the state of $\overline{EN}$ or $\overline{SHDN}$. This allows for Ring Indicator applications without forward biasing other devices connected to the receiver outputs. This is ideal for systems where V_{CC} is set to 0V in shutdown to accommodate peripherals, such as UARTs (Figure 2).

MAX3222/MAX3237/MAX3241 Shutdown Mode

Supply current falls to less than 1µA in shutdown mode ($\overline{SHDN}$ = low). When shut down, the device's charge pumps are turned off, V+ is pulled down to V_{CC}, V- is pulled to ground, and the transmitter outputs are disabled (high impedance). The time required to exit shutdown is typically 100µs, as shown in Figure 3. Connect $\overline{SHDN}$ to V_{CC} if the shutdown mode is not used. $\overline{SHDN}$ has no effect on R_OUT or R_OUTB.

MAX3222/MAX3237/MAX3241 Enable Control

The inverting receiver outputs (R_OUT) are put into a high-impedance state when $\overline{EN}$ is high. The complementary outputs R1OUTB and R2OUTB are always active, regardless of the state of $\overline{EN}$ and $\overline{SHDN}$ (Table 1). $\overline{EN}$ has no effect on T_OUT.

_____Applications Information

Capacitor Selection

The capacitor type used for C1–C4 is not critical for proper operation; polarized or nonpolarized capacitors can be used. The charge pump requires 0.1µF capacitors for 3.3V operation. For other supply voltages, refer to Table 2 for required capacitor values. Do not use values smaller than those listed in Table 2. Increasing the capacitor values (e.g., by a factor of 2) reduces ripple on the transmitter outputs and slightly reduces power consumption. C2, C3, and C4 can be increased without changing C1's value. However, do not increase C1 without also increasing the values of C2, C3, and C4, to maintain the proper ratios (C1 to the other capacitors).

When using the minimum required capacitor values, make sure the capacitor value does not degrade excessively with temperature. If in doubt, use capacitors with a larger nominal value. The capacitor's equivalent series resistance (ESR), which usually rises at low temperatures, influences the amount of ripple on V+ and V-.

a) OLDER RS-232: POWERED-DOWN UART DRAWS CURRENT FROM ACTIVE RECEIVER OUTPUT IN SHUTDOWN.

b) NEW MAX3237/MAX3241: $\overline{EN}$ SHUTS DOWN RECEIVER OUTPUTS (EXCEPT FOR B OUTPUTS), SO NO CURRENT FLOWS TO UART IN SHUTDOWN. B OUTPUTS INDICATE RECEIVER ACTIVITY DURING SHUTDOWN WITH EN HIGH.

Figure 2. Detection of RS-232 Activity when the UART and Interface are Shut Down; Comparison of MAX3237/MAX3241 (b) with Previous Transceivers (a).

MAXIM

3.0V to 5.5V, Low-Power, up to 1Mbps, True RS-232 Transceivers Using Four 0.1µF External Capacitors

Table 1. MAX3222/MAX3237/MAX3241 Shutdown and Enable Control Truth Table

SHDN	EN	T_OUT	R_OUT	R_OUTB (MAX3237/ MAX3241)
0	0	High-Z	Active	Active
0	1	High-Z	High-Z	Active
1	0	Active	Active	Active
1	1	Active	High-Z	Active

Table 2. Required Minimum Capacitor Values

V_CC (V)	C1 (µF)	C2, C3, C4 (µF)
MAX3222/MAX3232/MAX3241		
3.0 to 3.6	0.1	0.1
4.5 to 5.5	0.047	0.33
3.0 to 5.5	0.1	0.47
MAX3237		
3.0 to 3.6	0.22	0.22
3.15 to 3.6	0.1	0.1
4.5 to 5.5	0.047	0.33
3.0 to 5.5	0.22	1.0

Power-Supply Decoupling
In most circumstances, a 0.1µF bypass capacitor is adequate. In applications that are sensitive to power-supply noise, decouple V_CC to ground with a capacitor of the same value as charge-pump capacitor C1. Connect bypass capacitors as close to the IC as possible.

Operation Down to 2.7V
Transmitter outputs will meet EIA/TIA-562 levels of ±3.7V with supply voltages as low as 2.7V.

Transmitter Outputs when Exiting Shutdown
Figure 3 shows two transmitter outputs when exiting shutdown mode. As they become active, the two transmitter outputs are shown going to opposite RS-232 levels (one transmitter input is high, the other is low). Each transmitter is loaded with 3kΩ in parallel with 2500pF. The transmitter outputs display no ringing or undesirable transients as they come out of shutdown. Note that the transmitters are enabled only when the magnitude of V- exceeds approximately 3V.

Mouse Driveability
The MAX3241 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 MAX3241 successfully drove all serial mice tested and met their respective current and voltage requirements. Figure 4a shows the transmitter output voltages under increasing load current at 3.0V. Figure 4b shows a typical mouse connection using the MAX3241.

Figure 3. Transmitter Outputs when Exiting Shutdown or Powering Up

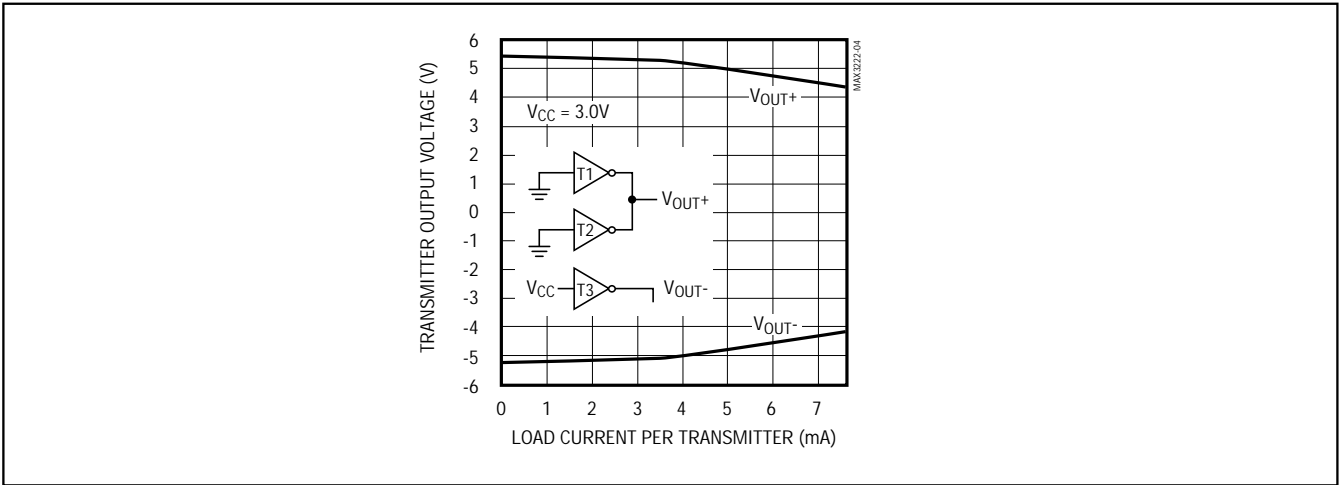# 3.0V to 5.5V, Low-Power, up to 1Mbps, True RS-232 Transceivers Using Four 0.1µF External Capacitors

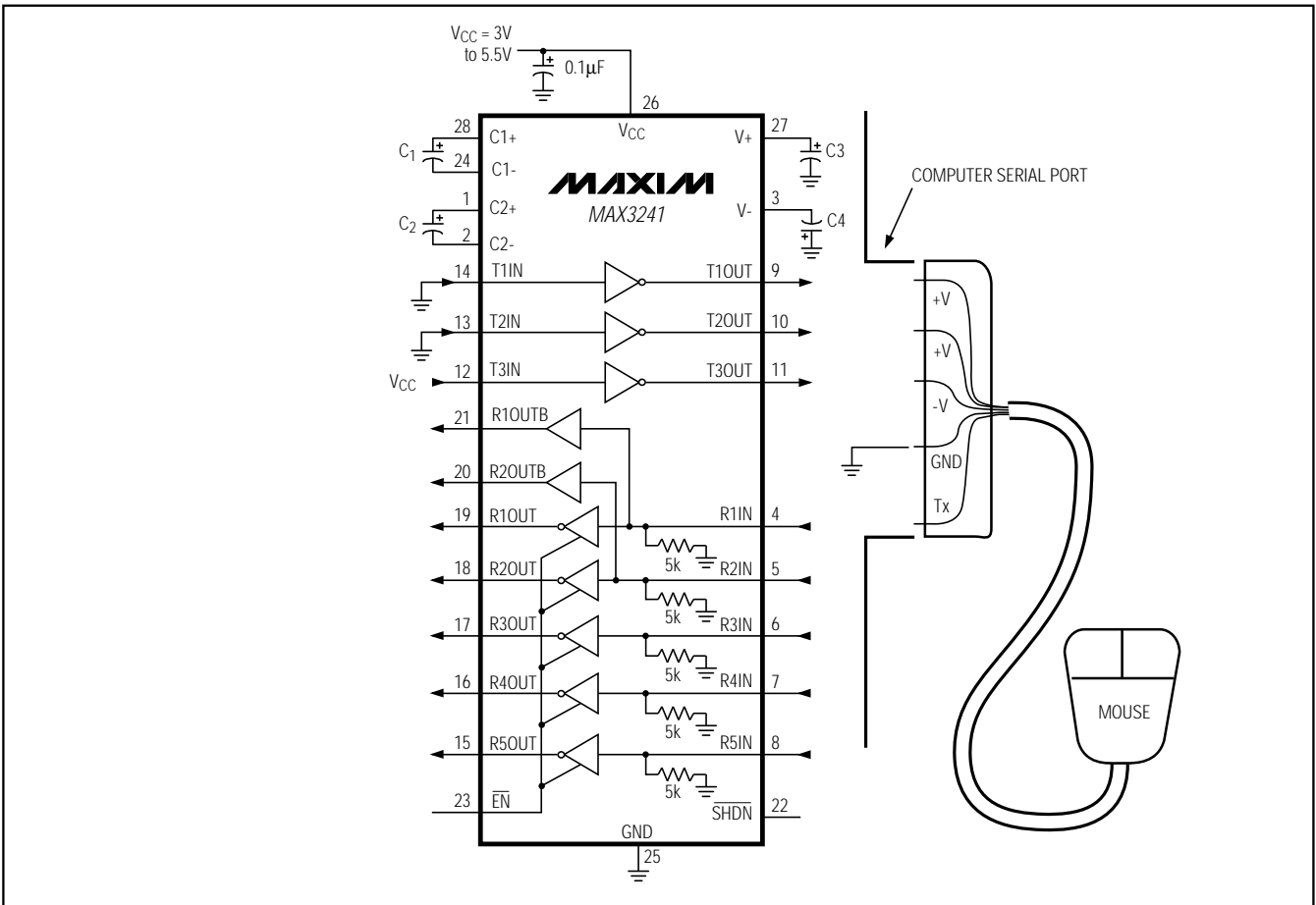*Figure 4a. MAX3241 Transmitter Output Voltage vs. Load Current per Transmitter*

Figure 4b. Mouse Driver Test Circuit

MAXIM

Figure 5. Loopback Test Circuit

Figure 6. MAX3241 Loopback Test Result at 120kbps
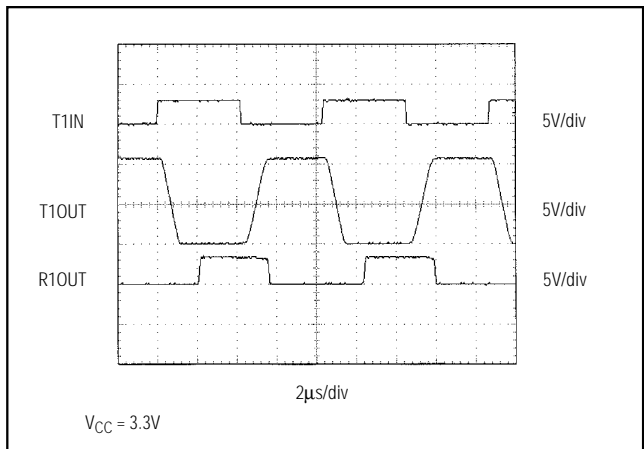
Figure 7. MAX3241 Loopback Test Result at 235kbps
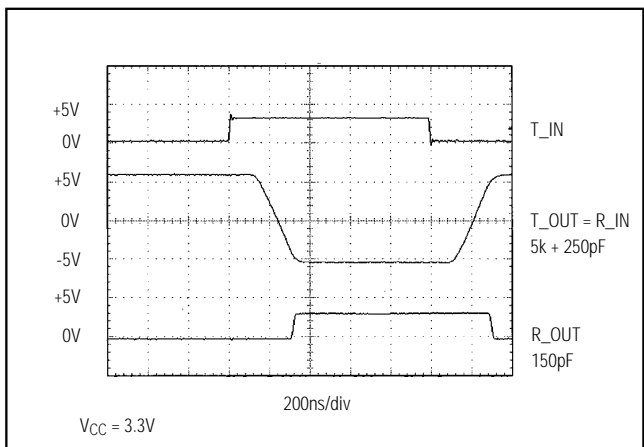
Figure 8. MAX3237 Loopback Test Result at 1000kbps (MBAUD = V_{CC})

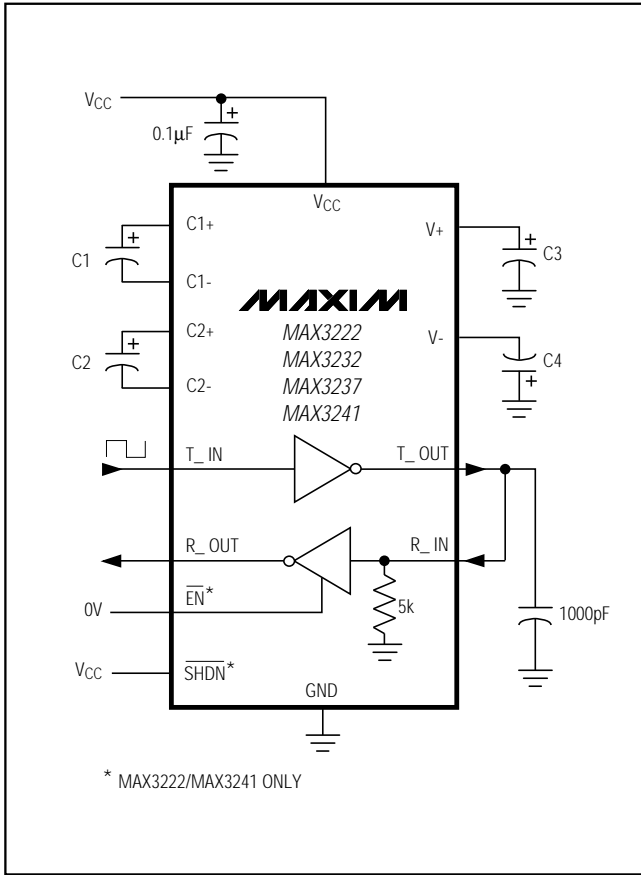### High Data Rates

The MAX3222/MAX3232/MAX3241 maintain the RS-232 ±5.0V minimum transmitter output voltage even at high data rates. Figure 5 shows a transmitter loopback test circuit. Figure 6 shows a loopback test result at 120kbps, and Figure 7 shows the same test at 235kbps. For Figure 6, all transmitters were driven simultaneously at 120kbps into RS-232 loads in parallel with 1000pF. For Figure 7, a single transmitter was driven at 235kbps, and all transmitters were loaded with an RS-232 receiver in parallel with 1000pF.

The MAX3237 maintains the RS-232 ±5.0V minimum transmitter output voltage at data rates up to 1Mbps. Figure 8 shows a loopback test result at 1Mbps with MBAUD = V_{CC}. For Figure 8, all transmitters were loaded with an RS-232 receiver in parallel with 250pF.
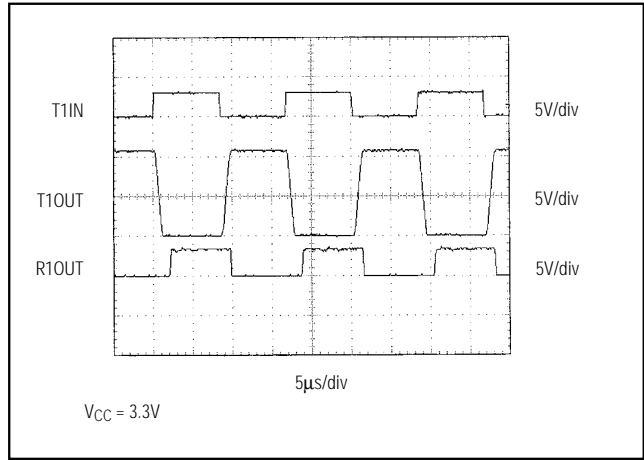
3.0V to 5.5V, Low-Power, up to 1Mbps, True RS-232 Transceivers Using Four 0.1µF External Capacitors
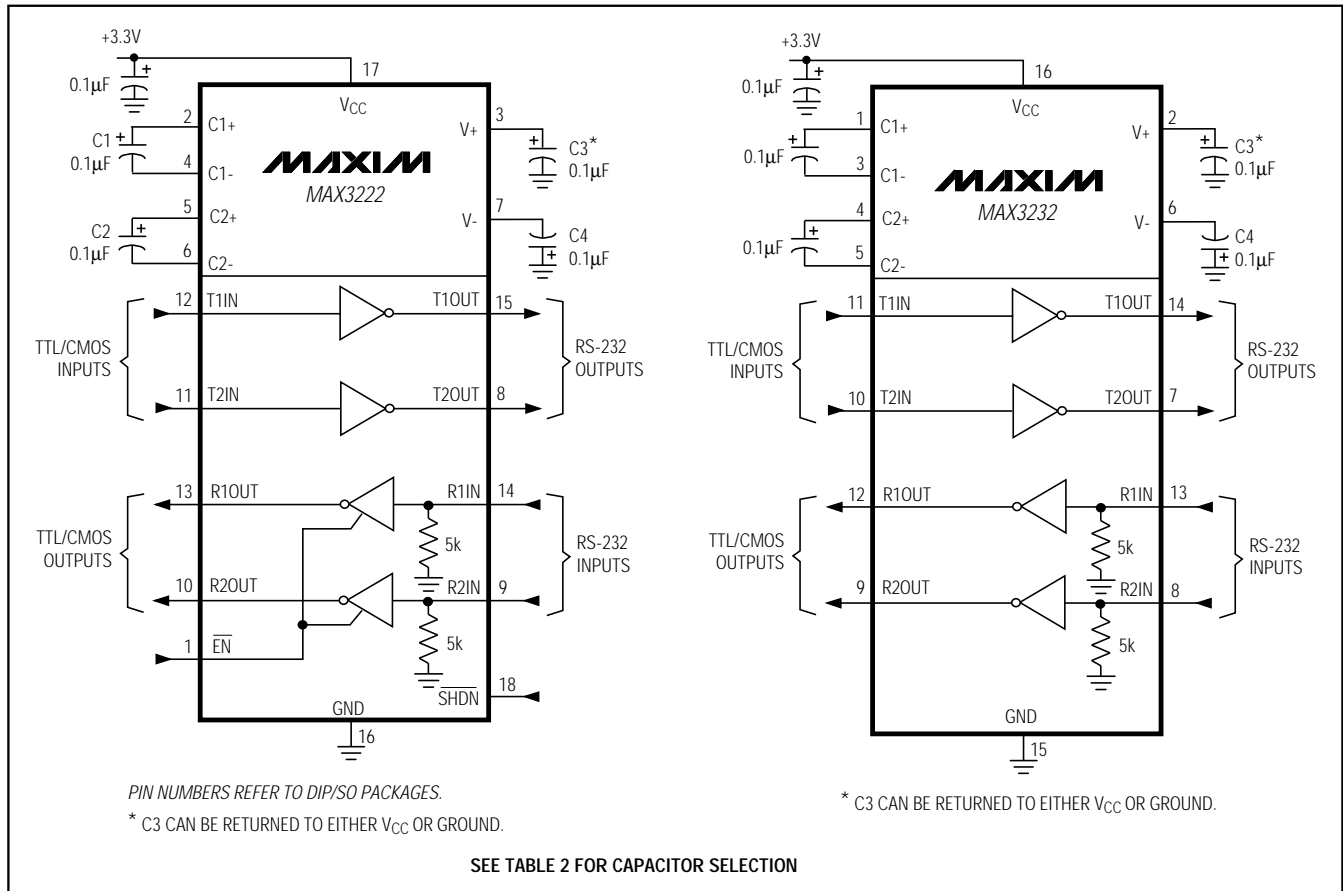
Interconnection with 3V and 5V Logic

The MAX3222/MAX3232/MAX3237/MAX3241 can directly interface with various 5V logic families, including ACT and HCT CMOS. See Table 3 for more information on possible combinations of interconnections.

Table 3. Logic-Family Compatibility with Various Supply Voltages

SYSTEM POWER-SUPPLY VOLTAGE (V)	MAX32_ _ V$_{CC}$ SUPPLY VOLTAGE (V)	COMPATIBILITY
3.3	3.3	Compatible with all CMOS families.
5	5	Compatible with all TTL and CMOS-logic families.
5	3.3	Compatible with ACT and HCT CMOS, and with TTL. Incompatible with AC, HC, and CD4000 CMOS.

_____ *Typical Operating Circuits*

PIN NUMBERS REFER TO DIP/SO PACKAGES.

* C3 CAN BE RETURNED TO EITHER V$_{CC}$ OR GROUND.

* C3 CAN BE RETURNED TO EITHER V$_{CC}$ OR GROUND.

SEE TABLE 2 FOR CAPACITOR SELECTION

MAXIM

_____Typical Operating Circuits (continued)
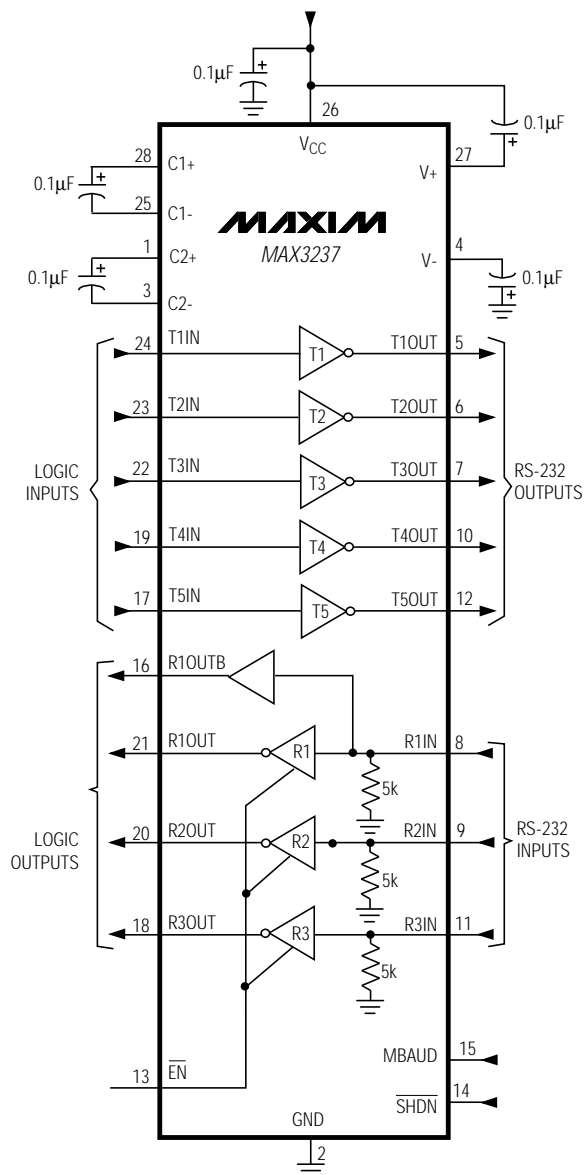
* C3 CAN BE RETURNED TO EITHER V$_{CC}$ OR GROUND.

* C3 CAN BE RETURNED TO EITHER V$_{CC}$ OR GROUND.

MAX3222/MAX3232/MAX3237/MAX3241

_____Pin Configurations (continued)

TOP VIEW

MAX3222 (SSOP)

Pin	Name		Pin	Name
1	$\overline{EN}$		20	$\overline{SHDN}$
2	C1+		19	V_{CC}
3	V+		18	GND
4	C1-		17	T1OUT
5	C2+		16	R1IN
6	C2-		15	R1OUT
7	V-		14	N.C.
8	T2OUT		13	T1IN
9	R2IN		12	T2IN
10	R2OUT		11	N.C.

MAX3232 (DIP/SO)

Pin	Name		Pin	Name
1	C1+		16	V_{CC}
2	V+		15	GND
3	C1-		14	T1OUT
4	C2+		13	R1IN
5	C2-		12	R1OUT
6	V-		11	T1IN
7	T2OUT		10	T2IN
8	R2IN		9	R2OUT

MAX3237 (SSOP)

Pin	Name		Pin	Name
1	C2+		28	C1+
2	GND		27	V+
3	C2-		26	V_{CC}
4	V-		25	C1-
5	T1OUT		24	T1IN
6	T2OUT		23	T2IN
7	T3OUT		22	T3IN
8	R1IN		21	R1OUT
9	R2IN		20	R2OUT
10	T4OUT		19	T4IN
11	R3IN		18	R3OUT
12	T5OUT		17	T5IN
13	$\overline{EN}$		16	R1OUTB
14	$\overline{SHDN}$		15	MBAUD

MAX3241 (SO/SSOP)

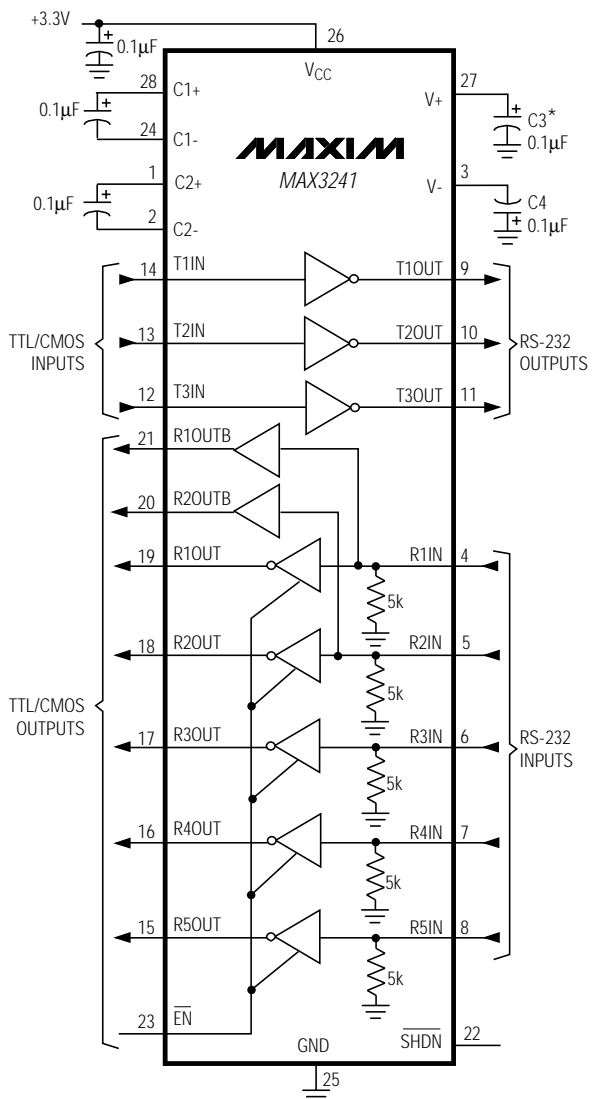| Pin	Name		Pin	Name
1	C2+		28	C1+
2	C2-		27	V+
3	V-		26	V_{CC}
4	R1IN		25	GND
5	R2IN		24	C1-
6	R3IN		23	$\overline{EN}$
7	R4IN		22	$\overline{SHDN}$
8	R5IN		21	R1OUTB
9	T1OUT		20	R2OUTB
10	T2OUT		19	R1OUT
11	T3OUT		18	R2OUT
12	T3IN		17	R3OUT
13	T2IN		16	R4OUT
14	T1IN		15	R5OUT

3.0V to 5.5V, Low-Power, up to 1Mbps, True RS-232 Transceivers Using Four 0.1µF External Capacitors

_Ordering Information (continued)

PART	TEMP. RANGE	PIN-PACKAGE
MAX3222C/D	0°C to +70°C	Dice*
MAX3222EPN	-40°C to +85°C	18 Plastic DIP
MAX3222EWN	-40°C to +85°C	18 SO
MAX3222EAP	-40°C to +85°C	20 SSOP
MAX3232CPE	0°C to +70°C	16 Plastic DIP
MAX3232CSE	0°C to +70°C	16 Narrow SO
MAX3232CWE	0°C to +70°C	16 Wide SO
MAX3232EPE	-40°C to +85°C	16 Plastic DIP
MAX3232ESE	-40°C to +85°C	16 Narrow SO
MAX3232EWE	-40°C to +85°C	16 Wide SO
MAX3237CAI	0°C to +70°C	28 SSOP
MAX3237EAI	-40°C to +85°C	28 SSOP
MAX3241CWI	0°C to +70°C	28 SO
MAX3241CAI	0°C to +70°C	28 SSOP
MAX3241EWI	-40°C to +85°C	28 SO
MAX3241EAI	-40°C to +85°C	28 SSOP

* Dice are tested at T_A = +25°C, DC parameters only.
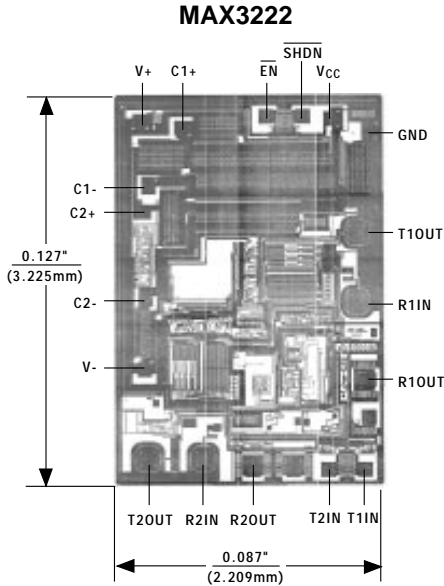
_____3V-Powered EIA/TIA-232 and EIA/TIA-562 Transceivers from Maxim

PART	POWER-SUPPLY VOLTAGE (V)	No. OF TRANSMITTERS/ RECEIVERS	No. OF RECEIVERS ACTIVE IN SHUTDOWN	GUAR-ANTEED DATA RATE (kbps)	EIA/ TIA-232 OR 562	FEATURES
MAX212	3.0 to 3.6	3/5	5	120	232	Drives mice
MAX218	1.8 to 4.25	2/2	2	120	232	Operates directly from batteries without a voltage regulator
MAX562	2.7 to 5.25	3/5	5	230	562	Wide supply range
MAX563	3.0 to 3.6	2/2	2	230	562	0.1µF capacitors
MAX3212	2.7 to 3.6	3/5	5	235	232	AutoShutdown, complementary receiver, drives mice, transient detection
MAX3222	3.0 to 5.5	2/2	2	120	232	0.1µF capacitors
MAX3223	3.0 to 5.5	2/2	2	120	232	0.1µF capacitors, AutoShutdown
MAX3232	3.0 to 5.5	2/2	N/A	120	232	0.1µF capacitors
MAX3237	3.0 to 5.5	5/3	3	250/1000	232	0.1µF capacitors, 1 complementary receiver, MegaBaud operation
MAX3241	3.0 to 5.5	3/5	5	120	232	0.1µF capacitors, 2 complementary receivers, drives mice
MAX3243	3.0 to 5.5	3/5	1	120	232	0.1µF capacitors, AutoShutdown, complementary receiver, drives mice

MAX3222/MAX3232/MAX3237/MAX3241

_____Chip Topography

MAX3222

V+ C1+ $\overline{EN}$ $\overline{SHDN}$ V_{CC}

GND

C1-
C2+

0.127"
(3.225mm)

T1OUT

R1IN

C2-

R1OUT

V-

T2OUT R2IN R2OUT T2IN T1IN

0.087"
(2.209mm)

TRANSISTOR COUNT: 339
SUBSTRATE CONNECTED TO GND

_____Chip Information

PART	TRANSISTOR COUNT
MAX3222	339
MAX3232	339
MAX3237	1212
MAX3241	894

_____Package Information

E H

α

C

L

e

A

B A1

D

**SSOP
SHRINK
SMALL-OUTLINE
PACKAGE**

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.068	0.078	1.73	1.99
A1	0.002	0.008	0.05	0.21
B	0.010	0.015	0.25	0.38
C	0.004	0.008	0.09	0.20
D	SEE VARIATIONS			
E	0.205	0.209	5.20	5.38
e	0.0256 BSC		0.65 BSC	
H	0.301	0.311	7.65	7.90
L	0.025	0.037	0.63	0.95
α	0°	8°	0°	8°

DIM	PINS	INCHES		MILLIMETERS	
		MIN	MAX	MIN	MAX
D	14	0.239	0.249	6.07	6.33
D	16	0.239	0.249	6.07	6.33
D	20	0.278	0.289	7.07	7.33
D	24	0.317	0.328	8.07	8.33
D	28	0.397	0.407	10.07	10.33

21-0056A