19-0306; Rev 8; 10/03

MAXIM

# 1µA Supply-Current, True +3V to +5.5V RS-232 Transceivers with AutoShutdown



## General Description

The MAX3221/MAX3223/MAX3243 achieve 1µA supply current with Maxim's revolutionary AutoShutdown™ feature. When the MAX3221/MAX3223/MAX3243 do not sense a valid signal level on their receiver inputs, the on-board power supply and drivers shut down. This occurs if the RS-232 cable is disconnected or if the transmitters of the connected peripheral are turned off. The system turns on again when a valid level is applied to any RS-232 receiver input. As a result, the system saves power without changes to the existing BIOS or operating system.

The MAX3221/MAX3223/MAX3243 transceivers are 3V-powered EIA/TIA-232 and V.28/V.24 communications interfaces intended for notebook computer applications. A proprietary, high-efficiency, dual charge-pump power supply and a low-dropout transmitter combine to deliver true RS-232 performance from a single +3.0V to +5.5V supply. A guaranteed data rate of 120kbps provides compatibility with popular software for communicating with personal computers.

The MAX3221/MAX3223/MAX3243 require only 0.1µF capacitors in 3.3V operation, and can operate from input voltages ranging from +3.0V to +5.5V. They are ideal for 3.3V-only systems, mixed 3.3V and 5.0V systems, or 5.0V-only systems that require true RS-232 performance.

The MAX3221 is a 1-driver/1-receiver 16-pin SSOP version of the 20-pin MAX3223 (2-driver/2-receiver). The MAX3243 3-driver/5-receiver, complete serial port is ideal for notebook or subnotebook computers. The MAX3243 includes one complementary always-active receiver. This receiver can monitor an external device (such as a modem) in shutdown, without forward biasing the protection diodes in a UART that may have $V_{CC}$ completely removed.

## Selector Guide

| PART | Tx | Rx | $V_{CC}$ RANGE (V) | AutoShutdown |
|---|---|---|---|---|
| MAX3221 | 1 | 1 | 3.0 to 5.5 | Yes |
| MAX3223 | 2 | 2 | 3.0 to 5.5 | Yes |
| MAX3243 | 3 | 5 | 3.0 to 5.5 | Yes |

***Pin Configurations appear at end of data sheet.***

***Typical Operating Circuits appear at end of data sheet.***

*†Future product—contact factory for availability.*

*AutoShutdown and UCSP are trademarks of Maxim Integrated Products, Inc.*

## Next Generation Device Features

- **For Space-Constrained Applications: MAX3228/MAX3229: +2.5V to +5.5V RS-232 Transceivers in UCSP™**
- **For Integrated ESD Protection: MAX3222E/MAX3232E/MAX3237E/MAX3241E/ MAX3246E: ±15kV ESD-Protected, Down to 10nA, 3.0V to 5.5V, Up to 1Mbps, True RS-232 Transceivers (MAX3246E Available in UCSP Package)**
- **For Low-Voltage or Data Cable Applications: MAX3380E/MAX3381E: +2.5V to +5.5V, 1µA, 2 Tx/2 Rx RS-232 Transceivers with ±15kV ESD-Protected I/O and Logic Pins**

## Applications

Notebook, Subnotebook, and Palmtop Computers

Battery-Powered Equipment

Hand-Held Equipment

Peripherals

Printers

## Ordering Information

| PART | TEMP RANGE | PIN-PACKAGE |
|---|---|---|
| **MAX3221**CAE | 0°C to +70°C | 16 SSOP |
| MAX3221CUE† | 0°C to +70°C | 16 TSSOP |
| MAX3221EAE | -40°C to +85°C | 16 SSOP |
| MAX3221EUE† | -40°C to +85°C | 16 TSSOP |
| **MAX3223**CPP | 0°C to +70°C | 20 Plastic DIP |
| MAX3223CAP | 0°C to +70°C | 20 SSOP |
| MAX3223CUP | 0°C to +70°C | 20 TSSOP |
| MAX3223EPP | -40°C to +85°C | 20 Plastic DIP |
| MAX3223EAP | -40°C to +85°C | 20 SSOP |
| MAX3223EUP | -40°C to +85°C | 20 TSSOP |
| **MAX3243**CWI | 0°C to +70°C | 28 Wide SO |
| MAX3243CAI | 0°C to +70°C | 28 SSOP |
| MAX3243CUI | 0°C to +70°C | 28 TSSOP |
| MAX3243EWI | -40°C to +85°C | 28 Wide SO |
| MAX3243EAI | -40°C to +85°C | 28 SSOP |
| MAX3243EUI | -40°C to +85°C | 28 TSSOP |



***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.***

# 1µA Supply-Current, True +3V to +5.5V RS-232 Transceivers with AutoShutdown

## 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, $\overline{FORCEOFF}$, FORCEON, $\overline{EN}$ (MAX3223) .....-0.3V to +6V
R_IN .....±25V
Output Voltages
T_OUT.....±13.2V
R_OUT, $\overline{INVALID}$ .....-0.3V to ($V_{CC}$ + 0.3V)
Short-Circuit Duration
T_OUT .....Continuous
Continuous Power Dissipation ($T_A$ = +70°C)
16-Pin SSOP (derate 7.14mW/°C above +70°C) .....571mW
16-Pin TSSOP (derate 6.70mW/°C above +70°C) .....533mW
20-Pin Plastic DIP (derate 11.11mW/°C above +70°C)....889mW
20-Pin SSOP (derate 8.00mW/°C above +70°C) .....640mW
20-Pin TSSOP DIP (derate 7.00mW/°C above +70°C).....559mW
28-Pin Wide SO (derate 12.50mW/°C above +70°C) .....1W
28-Pin SSOP (derate 9.52mW/°C above +70°C) .....762mW
28-Pin TSSOP (derate 8.70mW/°C above +70°C) .....696mW
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, 10s) .....+300°C

**Note 1:** V+ and V- can have maximum magnitudes 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 rating s only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specificatio ns 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** | | | | | | |
| Supply Current, AutoShutdown | $V_{CC}$ = 3.3V or 5.0V, $T_A$ = +25°C | All R_IN open, FORCEON = GND, $\overline{FORCEOFF}$ = $V_{CC}$ | | 1.0 | 10 | µA |
| Supply Current, Shutdown | | $\overline{FORCEOFF}$ = GND | | 1.0 | 10 | µA |
| Supply Current, AutoShutdown Disabled | | FORCEON = $\overline{FORCEOFF}$ = $V_{CC}$, no load | | 0.3 | 1.0 | mA |
| **LOGIC INPUTS AND RECEIVER OUTPUTS** | | | | | | |
| Input Logic Threshold Low | T_IN, FORCEON, $\overline{FORCEOFF}$, $\overline{EN}$ (MAX3223) | | | | 0.8 | V |
| Input Logic Threshold High | T_IN, EN, FORCEON, $\overline{FORCEOFF}$ | $V_{CC}$ = 3.3V | 2.0 | | | V |
| | | $V_{CC}$ = 5.0V | 2.4 | | | |
| Input Leakage Current | T_IN, EN, FORCEON, $\overline{FORCEOFF}$ | | | ±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 |
| **AUTOSHUTDOWN** (FORCEON = GND, $\overline{FORCEOFF}$ = $V_{CC}$) | | | | | | |
| Receiver Input Thresholds to Transmitters Enabled | Figure 5 | Positive threshold | | | 2.7 | V |
| | | Negative threshold | -2.7 | | | |
| Receiver Input Thresholds to Transmitters Disabled | 1µA supply current, Figure 5 | | -0.3 | | 0.3 | V |
| $\overline{INVALID}$ Output Voltage Low | $I_{OUT}$ = 1.6mA | | | | 0.4 | V |
| $\overline{INVALID}$ Output Voltage High | $I_{OUT}$ = -1.0mA | | $V_{CC}$ - 0.6 | | | V |
| Receiver Threshold to Transmitters Enabled ($t_{WU}$) | Figure 5 | | | 250 | | µs |
| Receiver Positive or Negative Threshold to $\overline{INVALID}$ High ($t_{INVH}$) | Figure 5 | | | 1 | | µs |
| Receiver Positive or Negative Threshold to $\overline{INVALID}$ Low ($t_{INVL}$) | Figure 5 | | | 30 | | µs |

## 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 |
|---|---|---|---|---|---|---|
| **RECEIVER INPUTS** | | | | | | |
| Input Voltage Range | | | -25 | | 25 | V |
| Input Threshold Low | $T_A$ = +25°C | $V_{CC}$ = 3.3V | 0.6 | 1.2 | | V |
| | | $V_{CC}$ = 5.0V | 0.8 | 1.5 | | |
| Input Threshold High | $T_A$ = +25°C | $V_{CC}$ = 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 |
| **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, transmitter output = ±2V | | 300 | 10M | | Ω |
| Output Short-Circuit Current | | | | ±35 | ±60 | mA |
| Output Leakage Current | $V_{OUT}$ = ±12V, $V_{CC}$ = 0V or 3.0V to 5.5V, transmitters disabled | | | | ±25 | µA |
| **MOUSE DRIVEABILITY** (MAX3243) | | | | | | |
| Transmitter Output Voltage | T1IN = T2IN = GND, T3IN = $V_{CC}$, T3OUT loaded with 3kΩ to GND, T1OUT and T2OUT loaded with 2.5mA each | | ±5 | | | V |
| **TIMING CHARACTERISTICS** | | | | | | |
| Maximum Data Rate | $R_L$ = 3kΩ, $C_L$ = 1000pF, one transmitter switching | | 120 | 235 | | kbps |
| Receiver Propagation Delay | Receiver input to receiver output, $C_L$ = 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 | $\lvert t_{PHL} - t_{PLH} \rvert$ | MAX3221/MAX3223 | | 200 | | ns |
| | | MAX3243 | | 200 | 1000 | |
| Receiver Skew | $\lvert t_{PHL} - t_{PLH} \rvert$ | MAX3221/MAX3223 | | 100 | | ns |
| | | MAX3243 | | 100 | 500 | |
| Transition-Region Slew Rate | $V_{CC}$ = 3.3V, $R_L$ = 3kΩ to 7kΩ, $T_A$ = +25°C, measured from +3V to -3V or -3V to +3V | $C_L$ = 200pF to 2500pF | 4 | 8.0 | 30 | V/µs |
| | | $C_L$ = 200pF to 1000pF | 6 | | 30 | |

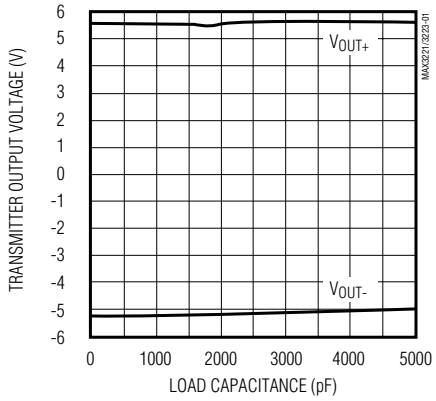
**Note 2:** C1–C4 = 0.1µF, tested at 3.3V ±10%. C1 = 0.047µF, C2–C4 = 0.33µF, tested at 5.0V ±10%.

# 1µA Supply-Current, True +3V to +5.5V RS-232 Transceivers with AutoShutdown

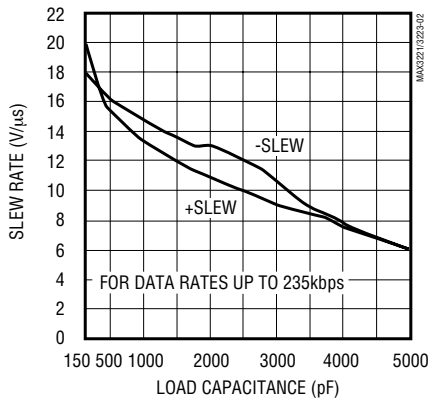
## Typical Operating Characteristics

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

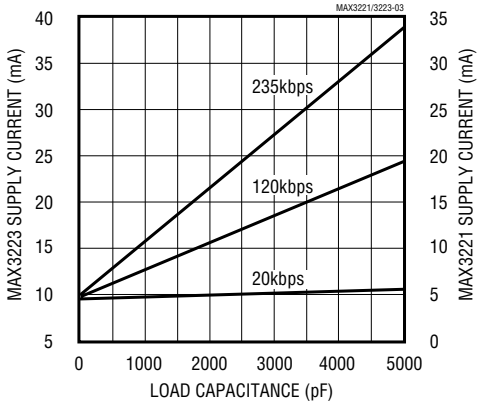
**MAX3221/MAX3223**
**TRANSMITTER OUTPUT VOLTAGE**
**vs. LOAD CAPACITANCE**



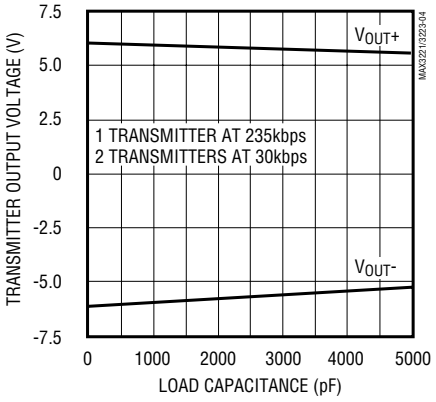

**MAX3221/MAX3223**
**SLEW RATE**
**vs. LOAD CAPACITANCE**



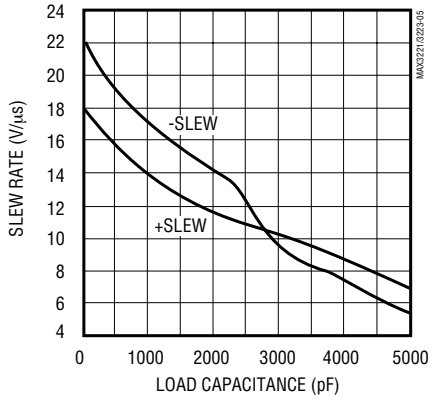

**MAX3221/MAX3223**
**SUPPLY CURRENT vs. LOAD CAPACITANCE**
**WHEN TRANSMITTING DATA**



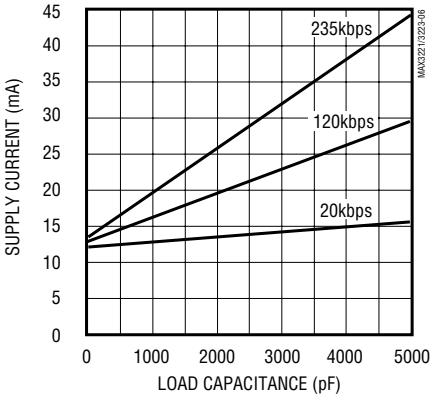

**MAX3243**
**TRANSMITTER OUTPUT VOLTAGE**
**vs. LOAD CAPACITANCE**




**MAX3243**
**SLEW RATE**
**vs. LOAD CAPACITANCE**




**MAX3243**
**SUPPLY CURRENT vs. LOAD**
**CAPACITANCE WHEN TRANSMITTING DATA**



# 1µA Supply-Current, True +3V to +5.5V RS-232 Transceivers with AutoShutdown

## Pin Description

| PIN | | | NAME | FUNCTION |
|---|---|---|---|---|
| MAX3221 | MAX3223 | MAX3243 | | |
| 1 | 1 | — | $\overline{EN}$ | Receiver Enable Control. Drive low for normal operation. Drive high to force the receiver outputs into a high-Z state. |
| 5 | 5 | 1 | C2+ | Positive terminal of inverting charge-pump capacitor |
| 6 | 6 | 2 | C2- | Negative terminal of inverting charge-pump capacitor |
| 7 | 7 | 3 | V- | -5.5V generated by the charge pump |
| 8 | 9, 16 | 4–8 | R_IN | RS-232 Receiver Inputs |
| 13 | 8, 17 | 9, 10, 11 | T_OUT | RS-232 Transmitter Outputs |
| 11 | 12, 13 | 12, 13, 14 | T_IN | TTL/CMOS Transmitter Inputs |
| 9 | 10, 15 | 15–19 | R_OUT | TTL/CMOS Receiver Outputs |
| — | — | 20 | R2OUTB | Noninverting Receiver Output—active in shutdown |
| 10 | 11 | 21 | $\overline{INVALID}$ | Output of the valid signal detector. Indicates if a valid RS-232 level is present on receiver inputs logic “1”. |
| 16 | 20 | 22 | $\overline{FORCEOFF}$ | Drive low to shut down transmitters and on-board power supply. This overrides all automatic circuitry and FORCEON (Table 1). |
| 12 | 14 | 23 | FORCEON | Drive high to override automatic circuitry keeping transmitters on ($\overline{FORCEOFF}$ must be high) (Table 1). |
| 4 | 4 | 24 | C1- | Negative terminal of the voltage doubler charge-pump capacitor |
| 14 | 18 | 25 | GND | Ground |
| 15 | 19 | 26 | $V_{CC}$ | +3.0V to +5.5V Supply Voltage |
| 3 | 3 | 27 | V+ | +5.5V generated by the charge pump |
| 2 | 2 | 28 | C1+ | Positive terminal of the voltage doubler charge-pump capacitor |

## Detailed Description

### Dual Charge-Pump Voltage Converter

The MAX3221/MAX3223/MAX3243’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; 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. They 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, the MAX3221/MAX3223/MAX3243 can operate at data rates of 235kbps. Transmitters can be paralleled to drive multiple receivers or mice (MAX3243). Figure 1 shows a complete system connection.

When $\overline{FORCEOFF}$ is driven to ground, or the AutoShutdown circuitry senses invalid voltage levels at all receiver inputs, the transmitters are disabled and the outputs are forced into a high-impedance state.

*LapLink is a trademark of Traveling Software.*

# 1µA Supply-Current, True +3V to +5.5V RS-232 Transceivers with AutoShutdown

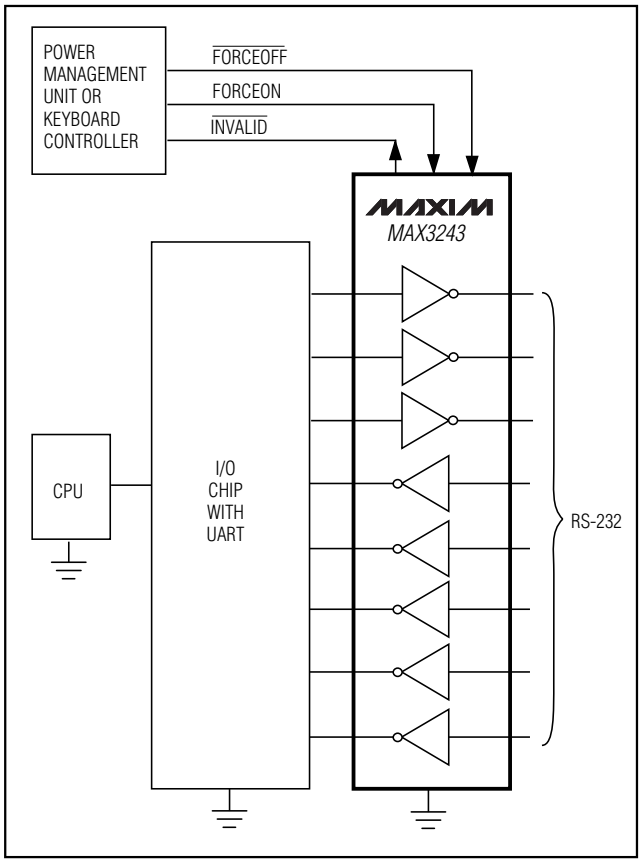



*Figure 1. Interface Under Control of PMU*

### RS-232 Receivers

The MAX3221/MAX3223/MAX3243's receivers convert RS-232 signals to CMOS-logic output levels. All receivers have one inverting three-state output. In shutdown (FORCEOFF = low) or in AutoShutdown, the MAX3221/MAX3223's receivers are active (Table 1). Driving EN high places the receiver(s) in a high-impedance state. The MAX3243's receivers are high impedance when the part is shut down.

The MAX3243 has an always-active complementary output (R2OUTB). R2OUTB is an extra output that monitors receiver activity while the other receivers are high impedance. This allows Ring Indicator to be monitored without forward biasing other devices connected to the receiver outputs. This is ideal for systems where VCC is set to 0V in shutdown to accommodate peripherals, such as UARTs (Figure 2).

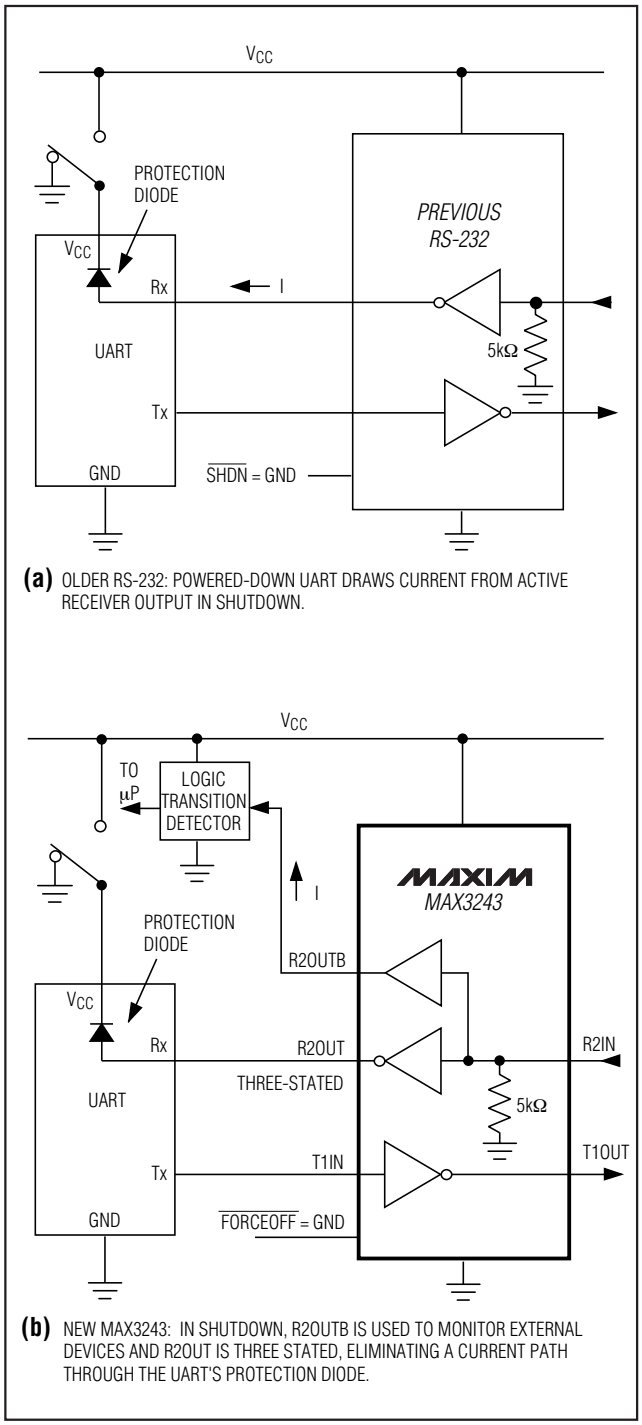



*Figure 2. The MAX3243 detects RS-232 activity when the UART and interface are shut down.*

**Table 1a. MAX3221/MAX3223 $\overline{\text{FORCEOFF}}$ and Enable Control Truth Table**

| $\overline{\text{FORCEOFF}}$ | $\overline{\text{EN}}$ | T_OUT | R_OUT |
|---|---|---|---|
| 0 | 0 | High-Z | Active |
| 0 | 1 | High-Z | High-Z |
| 1 | 0 | Active* | Active |
| 1 | 1 | Active* | High-Z |

**Table 1b. MAX3243 $\overline{\text{FORCEOFF}}$ Control Truth Table**

| $\overline{\text{FORCEOFF}}$ | T_OUT | R_OUT | R2OUTB |
|---|---|---|---|
| 0 | High-Z | High-Z | Active |
| 1 | Active* | Active* | Active |

***Note:** If the part is in AutoShutdown mode ($\overline{\text{FORCEOFF}}$ = $V_{CC}$, FORCEON = GND), it is shut down if no valid RS-232 levels are present on all receiver inputs.

### AutoShutdown

A 1µA supply current is achieved with Maxim's new AutoShutdown feature, which operates when FORCEON is low and $\overline{\text{FORCEOFF}}$ is high. When the MAX3221/MAX3223/MAX3243 sense no valid signal levels on all receiver inputs for 30µs, the on-board power supply and drivers are shut off, reducing supply current to 1µA. This occurs if the RS-232 cable is disconnected or the connected peripheral transmitters are turned off. The system turns on again when a valid level is applied to any RS-232 receiver input. As a result, the system saves power without changes to the existing BIOS or operating system. When using AutoShutdown, the $\overline{\text{INVALID}}$ output is high when the device is on and low when the device is shut down. Because $\overline{\text{INVALID}}$ indicates the receiver inputs' condition, it can be used in any mode (Figure 3).

Table 2 and Figure 3c summarize the MAX3221/MAX3223/MAX3243 operating modes. FORCEON and $\overline{\text{FORCEOFF}}$ override the automatic circuitry and force the transceiver into its normal operating state or into its low-power standby state. When neither control is asserted, the IC selects between these states automatically based on receiver input levels. Figures 3a, 3b, and 5a depict valid and invalid RS-232 receiver levels.

A mouse or other system with AutoShutdown may need time to wake up. Figure 4 shows a circuit that forces the transmitters on for 100ms, allowing enough time for the

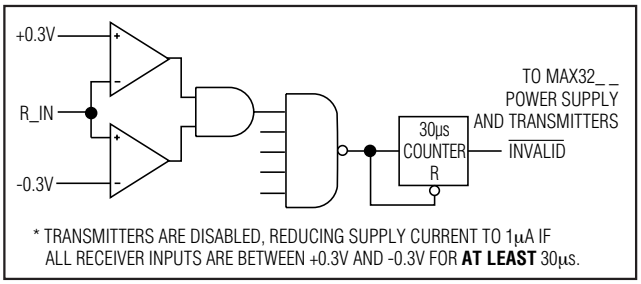



*Figure 3a. MAX32_ _ Entering 1µA Supply Mode via AutoShutdown*

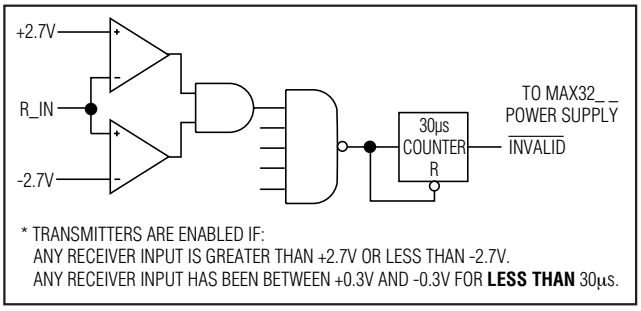



*Figure 3b. MAX32_ _ with Transmitters Enabled Using AutoShutdown*

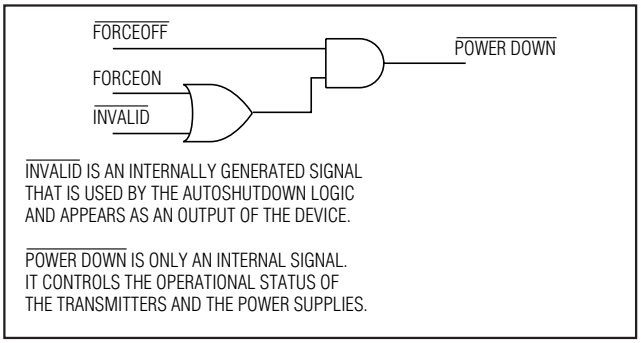



*Figure 3c. AutoShutdown Logic*

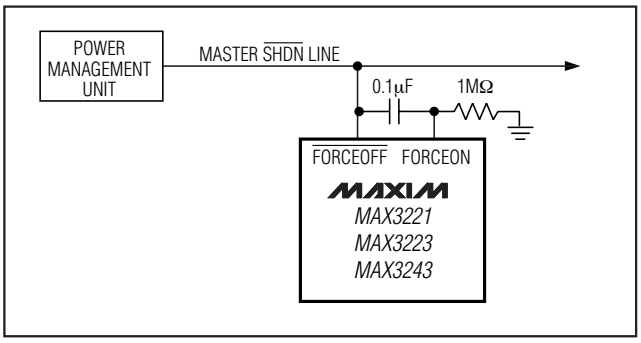



*Figure 4. AutoShutdown with Initial Turn-On to Wake Up a Mouse or Another System*

# 1µA Supply-Current, True +3V to +5.5V RS-232 Transceivers with AutoShutdown

**Table 2. AutoShutdown Logic**

| RS-232 SIGNAL PRESENT AT RECEIVER INPUT | $\overline{\text{FORCEOFF}}$ INPUT | FORCEON INPUT | $\overline{\text{INVALID}}$ OUTPUT | TRANSCEIVER STATUS |
|---|---|---|---|---|
| Yes | H | X | H | Normal Operation |
| No | H | H | L | Normal Operation (Forced On) |
| No | H | L | L | Shutdown (AutoShutdown) |
| Yes | L | X | H | Shutdown (Forced Off) |
| No | L | X | L | Shutdown (Forced Off) |

other system to realize that the MAX3221/MAX3223/MAX3243 is awake. If the other system outputs valid RS-232 signals within that time, the RS-232 ports on both systems remain enabled.

When shut down, the device's charge pumps are turned off, V+ decays to $V_{CC}$, V- decays to ground, and the transmitter outputs are disabled (high impedance). The time required to exit shutdown is typically 100µs (Figure 5b).

### Software-Controlled Shutdown

If direct software control is desired, $\overline{\text{INVALID}}$ can be used to indicate DTR or Ring Indicator signal. Tie $\overline{\text{FORCEOFF}}$ and FORCEON together to bypass AutoShutdown so the line acts like a $\overline{\text{SHDN}}$ input.

## Applications Information

### Capacitor Selection

The capacitor type used for C1–C4 is not critical for proper operation; either polarized or nonpolarized capacitors may be used. The charge pump requires 0.1µF capacitors for 3.3V operation. For other supply voltages, refer to Table 3 for required capacitor values. Do not use values smaller than those listed in Table 3. 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) usually rises at low temperatures and influences the amount of ripple on V+ and V-.

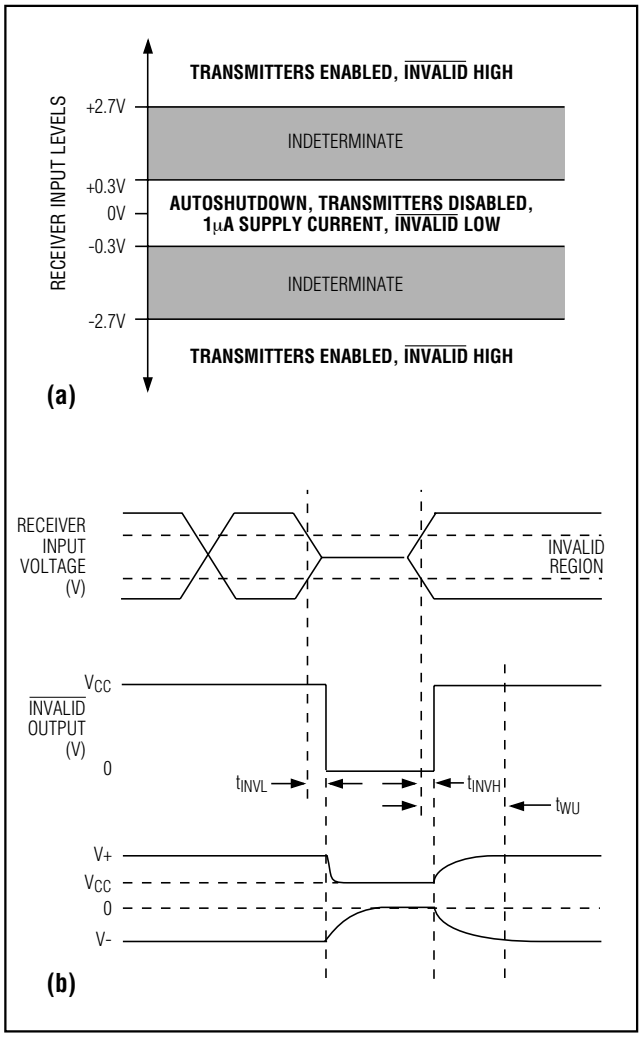



*Figure 5. AutoShutdown Trip Levels*

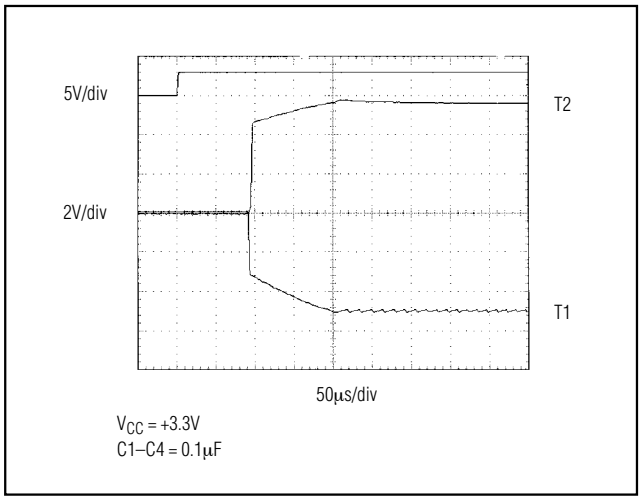



*Figure 6. Transmitter Outputs when Exiting Shutdown or Powering Up*

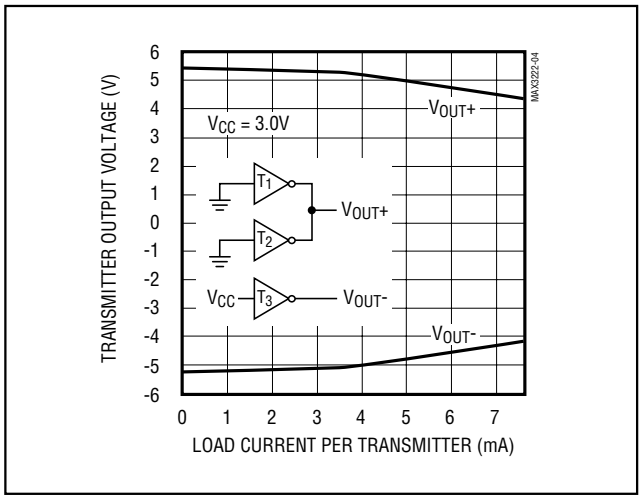



*Figure 7a. MAX3243 Transmitter Output Voltage vs. Load Current per Transmitter*

### 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 the charge-pump capacitor C1. Connect bypass capacitors as close to the IC as possible.

### Transmitter Outputs when Exiting Shutdown

Figure 6 shows two transmitter outputs when exiting shutdown mode. As they become active, the two transmitter outputs are shown going to opposite RS-232 levels. 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. Figure 7a shows the MAX3243's transmitter output voltage vs. current per transmitter. Figure 7b is a mouse driver test circuit.

### Mouse Driveability (MAX3243)

The MAX3243 has been specifically designed to power serial mice while operating from low-voltage power supplies. It has been tested with samples of ten major mouse models from six manufacturers including the leading three: Logitech (5 models), Mouse Systems, and Microsoft. The MAX3243 successfully drove all serial mice and met their respective current and voltage requirements. Figure 7a shows the transmitter outputs under increasing load current. The MAX3243's switching regulator ensures the transmitters will supply at least ±5V during worst-case conditions. The AutoShutdown feature does not work with a mouse, so $\overline{\text{FORCEOFF}}$ and FORCEON should be connected to $V_{CC}$.

### High Data Rates

The MAX3221/MAX3223/MAX3243 maintain the RS-232 ±5.0V minimum transmitter output voltage even at high data rates. Figure 8 shows a transmitter loopback test circuit. Figure 9 shows a loopback test result at 120kbps, and Figure 10 shows the same test at 235kbps. For Figure 9, all three transmitters were driven simultaneously at 120kbps into RS-232 loads in parallel with 1000pF. For Figure 10, a single transmitter was driven at 235kbps, but all three transmitters were loaded with an RS-232 receiver in parallel with 1000pF.

### Interconnection with 3V and 5V Logic

The MAX3221/MAX3223/MAX3243 can directly interface with various 5V logic families, including ACT and HCT CMOS. See Table 4 for more information on possible combinations of interconnections.

# 1µA Supply-Current, True +3V to +5.5V RS-232 Transceivers with AutoShutdown

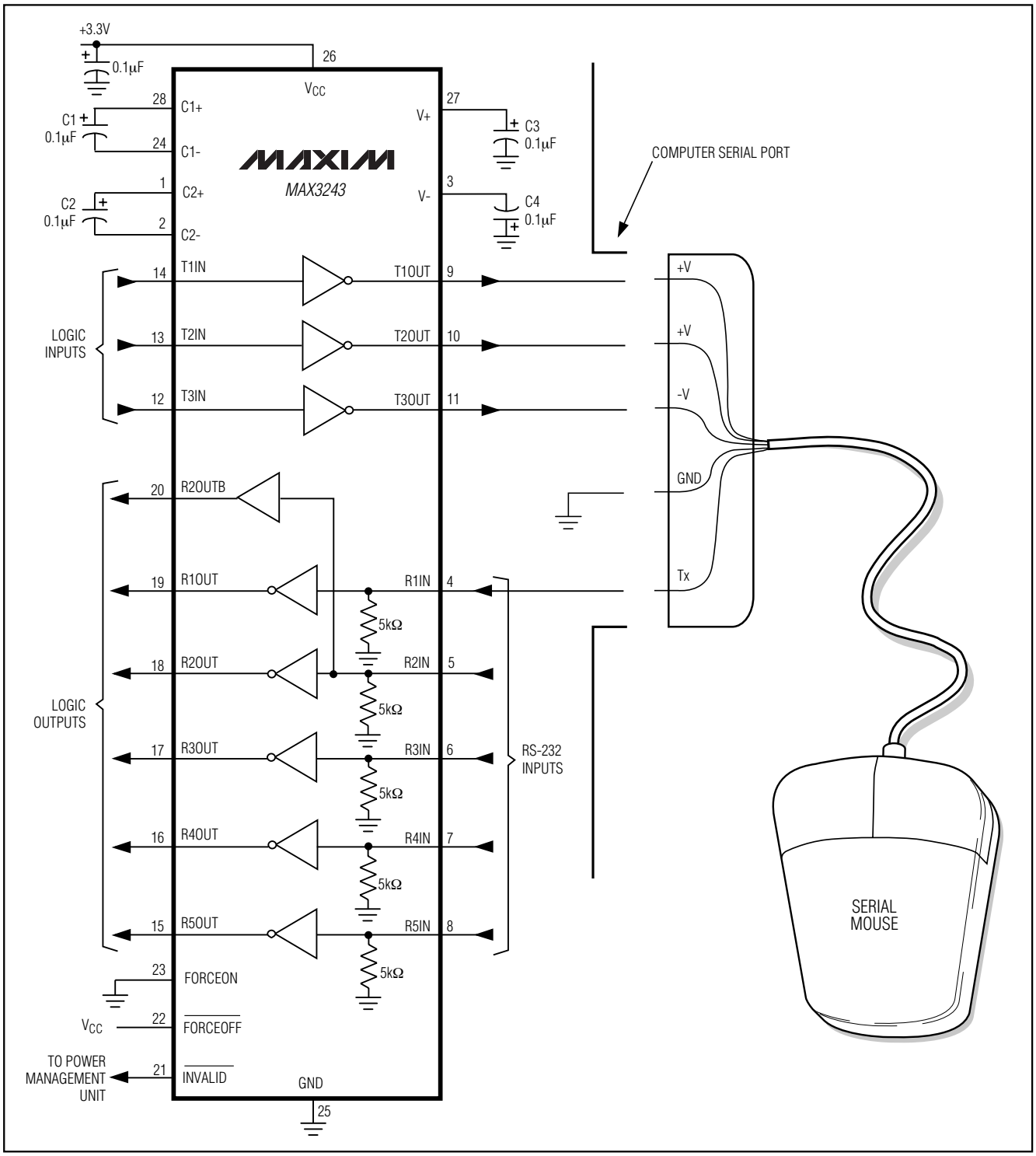



*Figure 7b. Mouse Driver Test Circuit*

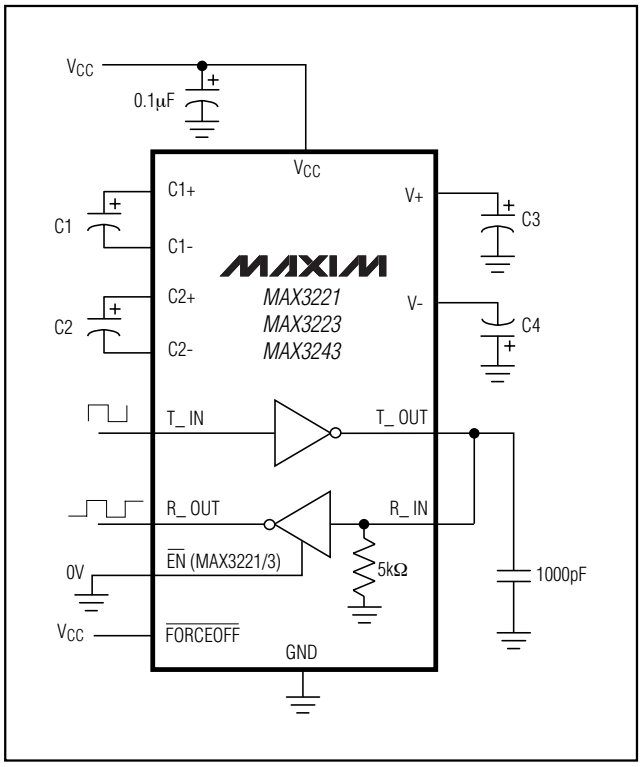



*Figure 8. Loopback Test Circuit*

**Table 3. Required Capacitor Values**

| $V_{CC}$ (V) | C1 (µF) | C2, C3, C4 (µF) |
|---|---|---|
| 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 |

**Table 4. Logic Family Compatibility with Various Supply Voltages**

| SYSTEM POWER-SUPPLY VOLTAGE (V) | $V_{CC}$ 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, or CD4000 CMOS. |

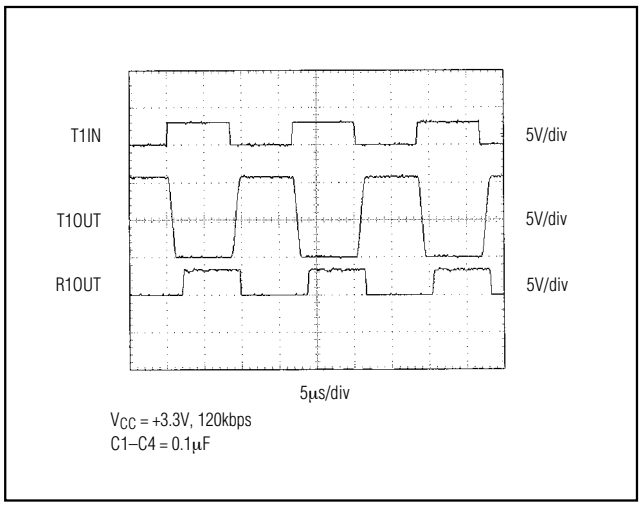



*Figure 9. Loopback Test Result at 120kbps*

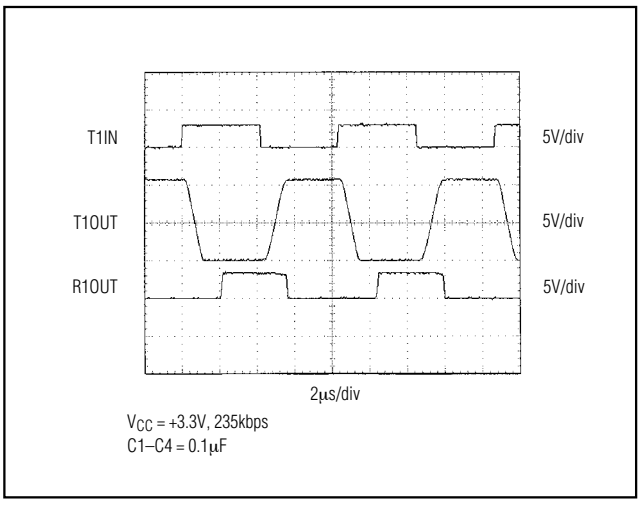
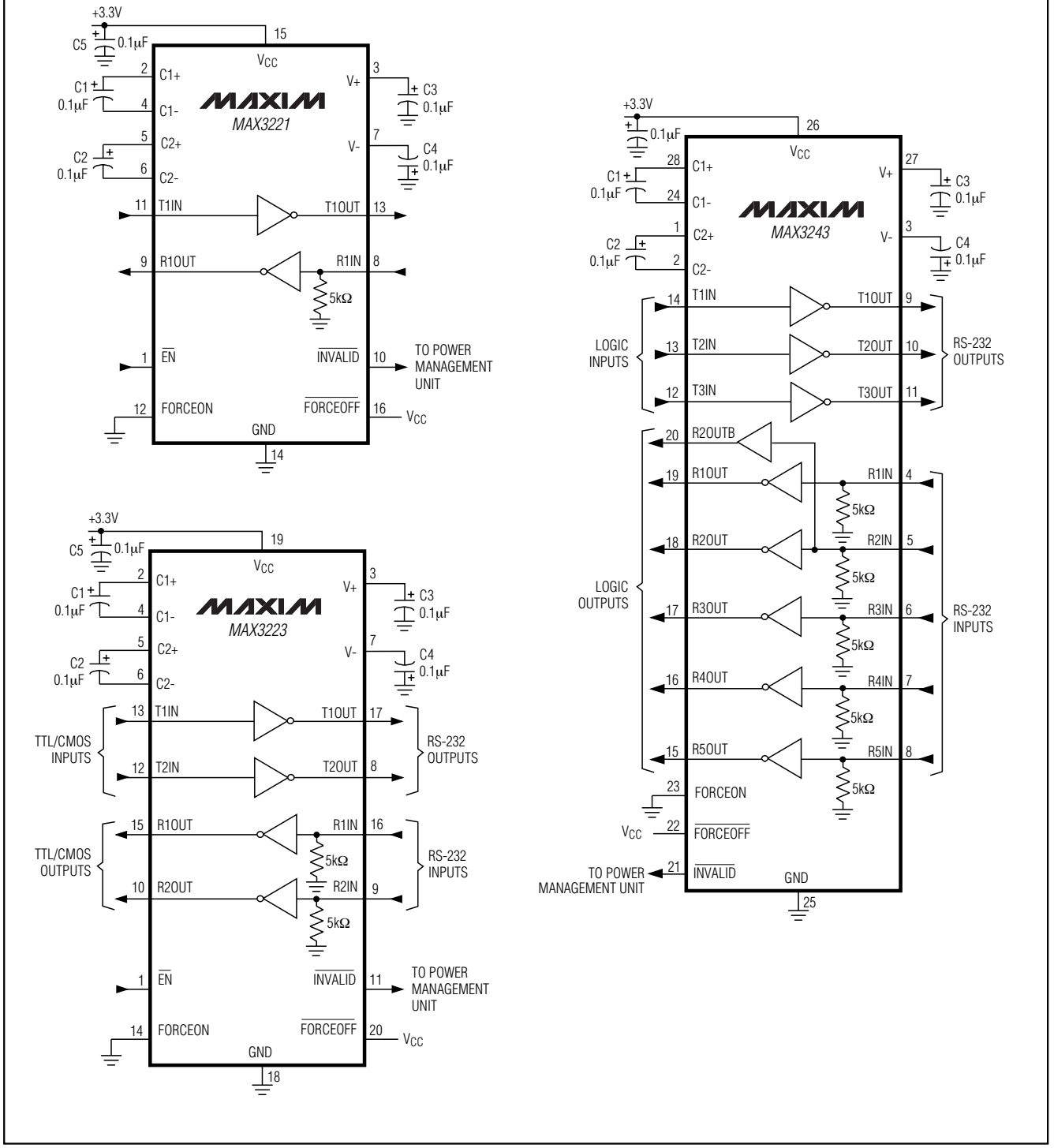



*Figure 10. Loopback Test Result at 235kbps*

# 1µA Supply-Current, True +3V to +5.5V RS-232 Transceivers with AutoShutdown

## Typical Operating Circuits



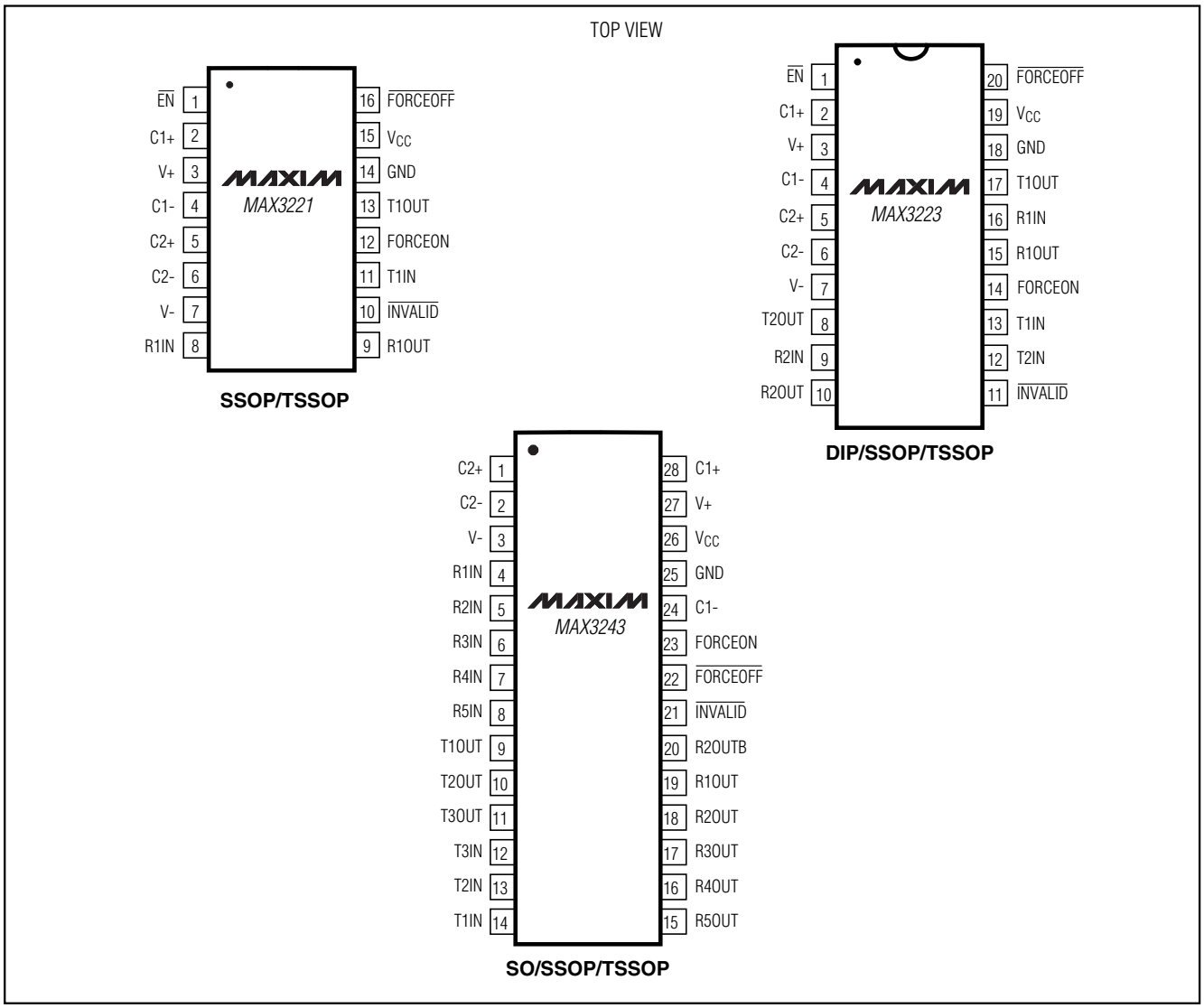
# 1µA Supply-Current, True +3V to +5.5V RS-232 Transceivers with AutoShutdown

## _____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 | 230kbps guaranteed data rate |
| MAX563 | 3.0 to 3.6 | 2/2 | 2 | 120 | 562 | 0.1µF capacitors |
| MAX3212 | 2.7 to 3.6 | 3/5 | 5 | 235 | 232 | AutoShutdown, complementary receiver, drives mice, transient detection |
| MAX3221 | 3.0 to 5.5 | 1/1 | 1 | 120 | 232 | 0.1µF capacitors, 16-pin SSOP |
| MAX3222 | 3.0 to 5.5 | 2/2 | 2 | 120 | 232 | 0.1µF capacitors, MAX242 pinout |
| 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, MAX232 pinout |
| 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 |

# 1µA Supply-Current, True +3V to +5.5V RS-232 Transceivers with AutoShutdown

## Pin Configurations




## Chip Information

MAX3221 TRANSISTOR COUNT: 269

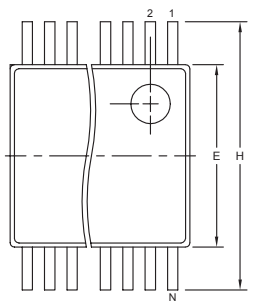
MAX3223 TRANSISTOR COUNT: 339

MAX3243 TRANSISTOR COUNT: 476

## 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**.)

SSOP.EPS



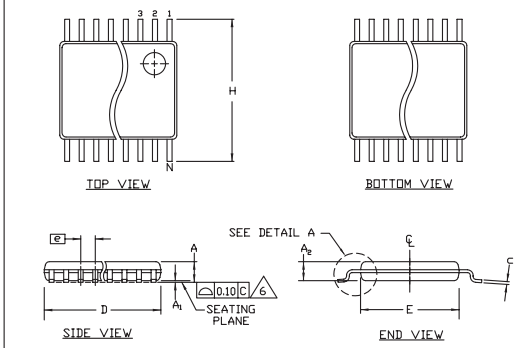

| DIM | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX |
|---|---|---|---|---|
| A | 0.068 | 0.078 | 1.73 | 1.99 |
| A1 | 0.002 | 0.008 | 0.05 | 0.21 |
| B | 0.010 | 0.015 | 0.25 | 0.38 |
| C | 0.004 | 0.008 | 0.09 | 0.20 |
| D | SEE VARIATIONS | | | |
| E | 0.205 | 0.212 | 5.20 | 5.38 |
| 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∞ |

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

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15 MM (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. MEETS JEDEC MO150.
5. LEADS TO BE COPLANAR WITHIN 0.10 MM.

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, SSOP, 5.3 MM
APPROVAL | DOCUMENT CONTROL NO. 21-0056 | REV. C | 1/1

TSSOP4.40mm.EPS




| SYMBOL | COMMON DIMENSIONS MILLIMETERS MIN. | MILLIMETERS MAX. | INCHES MIN. | INCHES MAX. |
|---|---|---|---|---|
| A | ——— | 1.10 | | .043 |
| $A_1$ | 0.05 | 0.15 | .002 | .006 |
| $A_2$ | 0.85 | 0.95 | .033 | .037 |
| b | 0.19 | 0.30 | .007 | .012 |
| $b_1$ | 0.19 | 0.25 | .007 | .010 |
| c | 0.09 | 0.20 | .004 | .008 |
| $c_1$ | 0.09 | 0.14 | .004 | .006 |
| D | SEE VARIATIONS | | SEE VARIATIONS | |
| E | 4.30 | 4.50 | .169 | .177 |
| e | 0.65 BSC | | .026 BSC | |
| H | 6.25 | 6.55 | .246 | .258 |
| L | 0.50 | 0.70 | .020 | .028 |
| N | SEE VARIATIONS | | SEE VARIATIONS | |
| α | 0° | 8° | 0° | 8° |

| JEDEC MO-153 | N | | VARIATIONS MILLIMETERS MIN. | MILLIMETERS MAX. | INCHES MIN. | INCHES MAX. |
|---|---|---|---|---|---|---|
| AB-1 | 14 | D | 4.90 | 5.10 | .193 | .201 |
| AB | 16 | D | 4.90 | 5.10 | .193 | .201 |
| AC | 20 | D | 6.40 | 6.60 | .252 | .260 |
| AD | 24 | D | 7.70 | 7.90 | .303 | .311 |
| AE | 28 | D | 9.60 | 9.80 | .378 | .386 |

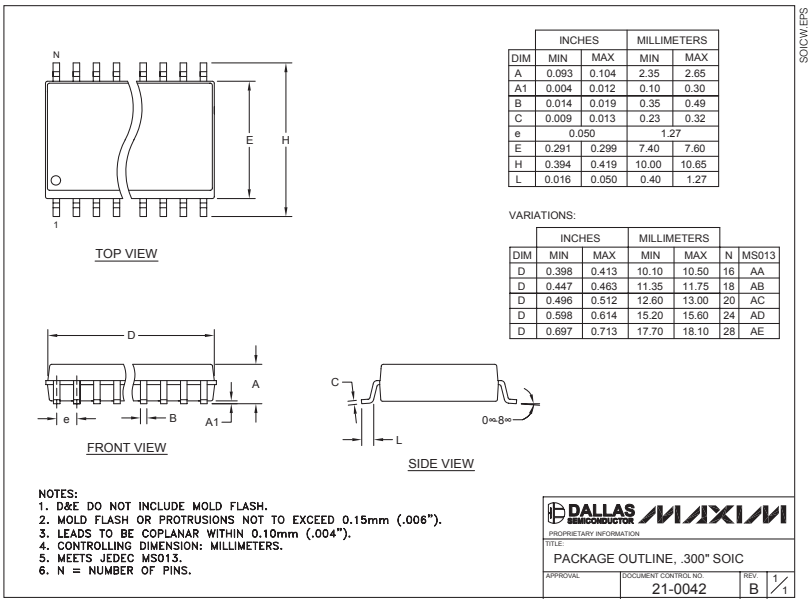
NOTES:
1. DIMENSIONS D AND E DO NOT INCLUDE FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm PER SIDE
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC OUTLINE MO-153. SEE JEDEC VARIATIONS TABLE
5. "N" REFERS TO NUMBER OF LEADS
6. THE LEAD TIPS MUST LIE WITHIN A SPECIFIED ZONE. THIS TOLERANCE ZONE IS DEFINED BY TWO PARALLEL PLANES. ONE PLANE IS THE SEATING PLANE, DATUM [-C-]; THE OTHER PLANE IS AT THE SPECIFIED DISTANCE FROM [-C-] IN THE DIRECTION INDICATED

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, TSSOP 4.40mm BODY
APPROVAL | DOCUMENT CONTROL NO. 21-0066 | REV. F | 1/1

# 1µA Supply-Current, True +3V to +5.5V RS-232 Transceivers with AutoShutdown

## Package Information (continued)

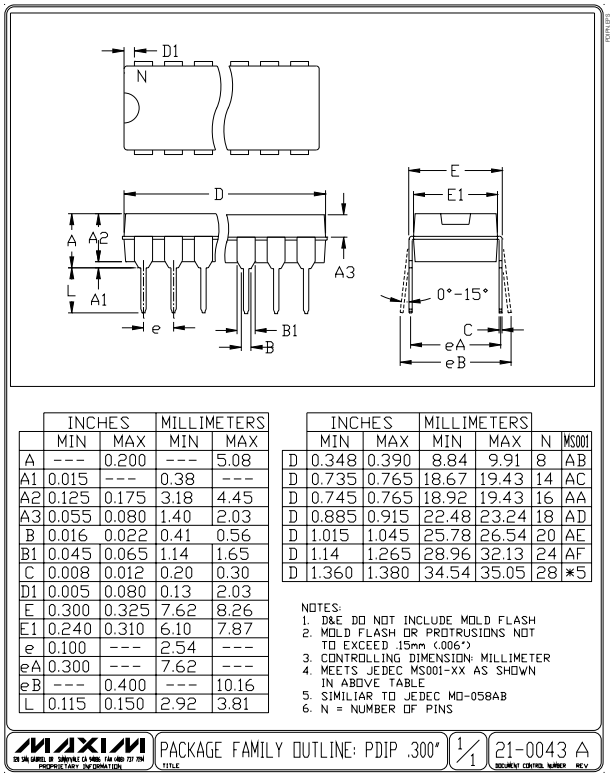
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)




| DIM | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX |
|---|---|---|---|---|
| A | 0.093 | 0.104 | 2.35 | 2.65 |
| A1 | 0.004 | 0.012 | 0.10 | 0.30 |
| B | 0.014 | 0.019 | 0.35 | 0.49 |
| C | 0.009 | 0.013 | 0.23 | 0.32 |
| e | 0.050 | | 1.27 | |
| E | 0.291 | 0.299 | 7.40 | 7.60 |
| H | 0.394 | 0.419 | 10.00 | 10.65 |
| L | 0.016 | 0.050 | 0.40 | 1.27 |

VARIATIONS:

| DIM | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX | N | MS013 |
|---|---|---|---|---|---|---|
| D | 0.398 | 0.413 | 10.10 | 10.50 | 16 | AA |
| D | 0.447 | 0.463 | 11.35 | 11.75 | 18 | AB |
| D | 0.496 | 0.512 | 12.60 | 13.00 | 20 | AC |
| D | 0.598 | 0.614 | 15.20 | 15.60 | 24 | AD |
| D | 0.697 | 0.713 | 17.70 | 18.10 | 28 | AE |




| | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX |
|---|---|---|---|---|
| A | --- | 0.200 | --- | 5.08 |
| A1 | 0.015 | --- | 0.38 | --- |
| A2 | 0.125 | 0.175 | 3.18 | 4.45 |
| A3 | 0.055 | 0.080 | 1.40 | 2.03 |
| B | 0.016 | 0.022 | 0.41 | 0.56 |
| B1 | 0.045 | 0.065 | 1.14 | 1.65 |
| C | 0.008 | 0.012 | 0.20 | 0.30 |
| D1 | 0.005 | 0.080 | 0.13 | 2.03 |
| E | 0.300 | 0.325 | 7.62 | 8.26 |
| E1 | 0.240 | 0.310 | 6.10 | 7.87 |
| e | 0.100 | --- | 2.54 | --- |
| eA | 0.300 | --- | 7.62 | --- |
| eB | --- | 0.400 | --- | 10.16 |
| L | 0.115 | 0.150 | 2.92 | 3.81 |

| | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX | N | MS001 |
|---|---|---|---|---|---|---|
| D | 0.348 | 0.390 | 8.84 | 9.91 | 8 | AB |
| D | 0.735 | 0.765 | 18.67 | 19.43 | 14 | AC |
| D | 0.745 | 0.765 | 18.92 | 19.43 | 16 | AA |
| D | 0.885 | 0.915 | 22.48 | 23.24 | 18 | AD |
| D | 1.015 | 1.045 | 25.78 | 26.54 | 20 | AE |
| D | 1.14 | 1.265 | 28.96 | 32.13 | 24 | AF |
| D | 1.360 | 1.380 | 34.54 | 35.05 | 28 | *5 |

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



© 2003 Maxim Integrated Products Printed USA MAXIM is a registered trademark of Maxim Integrated Products.

Общество с ограниченной ответственностью «МосЧип» ИНН 7719860671 / КПП 771901001
Адрес: 105318, г.Москва, ул.Щербаковская д.3, офис 1107

**Данный компонент на территории Российской Федерации**

**Вы можете приобрести в компании MosChip.**

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

http://moschip.ru/get-element

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

**Офис по работе с юридическими лицами:**

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:
moschip.ru
moschip.ru_4
moschip.ru_6
moschip.ru_9