

# MAX200–MAX209/ MAX211/MAX213

## +5V, RS-232 Transceivers with 0.1μF External Capacitors

### General Description

MAX200-MAX209, MAX211, and MAX213 are a family of RS-232 and V.28 transceivers with integrated charge pump circuitry for single +5V supply operation.

The drivers maintain the  $\pm 5V$  EIA/TIA-232E output signal levels at data rates in excess of 120kbps when loaded in accordance with the EIA/TIA-232E specification.

The MAX211 and MAX213 are available in a 28-pin, wide small-outline (SO) package and a 28-pin shrink small-outline (SSOP) package, which occupies only 40% of the area of the SO. The MAX207 is available in a 24-pin SO package and a 24-pin SSOP. The MAX203 and MAX205 use no external components and are recommended for applications with limited circuit board space.

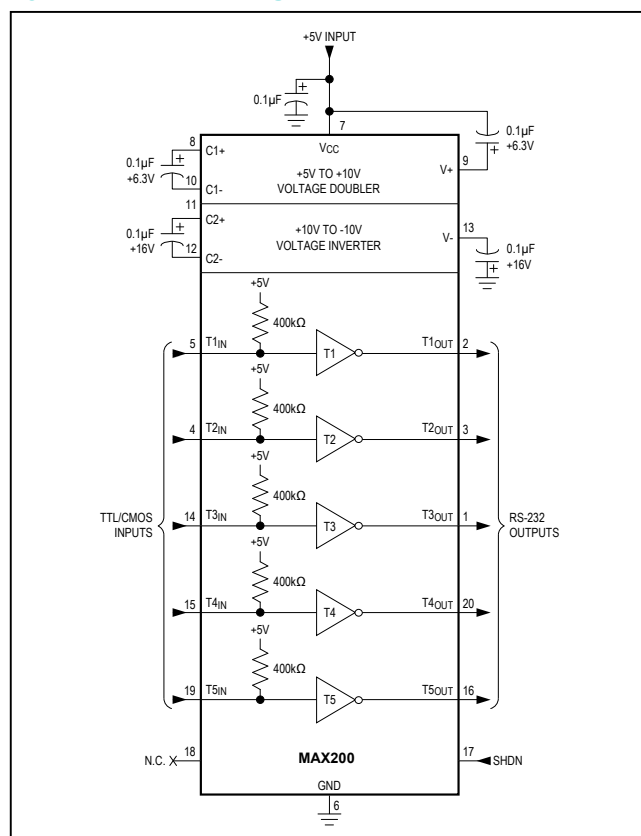
### Benefits and Features

- Saves Board Space
  - Integrated Charge Pump Circuitry
    - Eliminates the Need for a Bipolar  $\pm 12V$  Supply
    - Enables Single Supply Operation From Either +5V or 9V to +12V
  - Integrated 0.1μF Capacitors (MAX203, MAX205)
  - 24 pin SSOP Package Saves Up to 40% Versus SO Package
- Saves Power for Longer Battery Operation
  - 5μW Shutdown Mode (MAX200, MAX205, MAX206, MAX211)
  - 75μW Ring Indicator Monitoring with Two Active Receivers (MAX213)

### Applications

- Battery-Powered Equipment
- Handheld Equipment
- Portable Diagnostics Equipment

### Typical Operating Circuit



### Selector Guide

| PART   | POWER-SUPPLY VOLTAGE (V) | NUMBER OF RS-232 DRIVERS | NUMBER OF RS-232 RECEIVERS | NUMBER OF RECEIVERS ACTIVE IN SHUTDOWN | NUMBER OF EXTERNAL CAPACITORS (0.1μF) | LOW-POWER SHUTDOWN/TTL THREE-STATE |
|--------|--------------------------|--------------------------|----------------------------|----------------------------------------|---------------------------------------|------------------------------------|
| MAX200 | +5                       | 5                        | 0                          | 0                                      | 4                                     | Yes/No                             |
| MAX201 | +5 and +9.0 to +13.2     | 2                        | 2                          | 0                                      | 2                                     | No/No                              |
| MAX202 | +5                       | 2                        | 2                          | 0                                      | 4                                     | No/No                              |
| MAX203 | +5                       | 2                        | 2                          | 0                                      | None                                  | No/No                              |

*Selector Guide continued at end of data sheet.*

# MAX200–MAX209/ MAX211/MAX213

## +5V, RS-232 Transceivers with 0.1µF External Capacitors

### Absolute Maximum Ratings

|                                                        |                                                    |
|--------------------------------------------------------|----------------------------------------------------|
| V <sub>CC</sub> .....                                  | -0.3V to +6V                                       |
| V <sub>+</sub> .....                                   | (V <sub>CC</sub> - 0.3V) to +14V                   |
| V <sub>-</sub> .....                                   | +0.3V to -14V                                      |
| Input Voltages                                         |                                                    |
| T <sub>IN</sub> .....                                  | -0.3V to (V <sub>CC</sub> + 0.3V)                  |
| R <sub>IN</sub> .....                                  | ±30V                                               |
| Output Voltages                                        |                                                    |
| T <sub>OUT</sub> .....                                 | (V <sub>+</sub> + 0.3V) to (V <sub>-</sub> - 0.3V) |
| R <sub>OUT</sub> .....                                 | -0.3V to (V <sub>CC</sub> + 0.3V)                  |
| Short-Circuit Duration                                 |                                                    |
| T <sub>OUT</sub> .....                                 | Continuous                                         |
| Continuous Power Dissipation (T <sub>A</sub> = +70°C)  |                                                    |
| 14-Pin Plastic DIP (derate 10.00mW/°C above +70°C) ... | 800mW                                              |
| 16-Pin Plastic DIP (derate 10.53mW/°C above +70°C) ... | 842mW                                              |
| 16-Pin SO (derate 8.70mW/°C above +70°C).....          | 696mW                                              |
| 16-Pin Wide SO (derate 9.52mW/°C above +70°C) ...      | 762mW                                              |
| 16-Pin Cerdip (derate 10.00mW/°C above +70°C).....     | 800mW                                              |
| 20-Pin Plastic DIP (derate 11.11mW/°C above +70°C) ... | 889mW                                              |

|                                                   |                 |
|---------------------------------------------------|-----------------|
| 20-Pin Wide SO (derate 10.00mW/°C above +70°C) .. | 800mW           |
| 20-Pin Cerdip (derate 11.11mW/°C above +70°C)...  | 889mW           |
| 24-Pin Narrow Plastic DIP                         |                 |
| (derate 13.33mW/°C above +70°C) .....             | 1067mW          |
| 24-Pin Wide Plastic DIP                           |                 |
| (derate 9.09mW/°C above +70°C) .....              | 727mW           |
| 24-Pin Wide SO (derate 11.76mW/°C above +70°C) .. | 941mW           |
| 24-Pin SSOP (derate 8.00mW/°C above +70°C).....   | 640mW           |
| 24-Pin Cerdip (derate 12.50mW/°C above +70°C) ... | 1000mW          |
| 28-Pin Wide SO (derate 12.50mW/°C above +70°C) .. | 1000mW          |
| 28-Pin SSOP (derate 9.52mW/°C above +70°C).....   | 762mW           |
| Operating Temperature Ranges                      |                 |
| MAX2__C__ .....                                   | 0°C to +70°C    |
| MAX2__E__ .....                                   | -40°C to +85°C  |
| MAX2__M__ .....                                   | -55°C to +125°C |
| Storage Temperature Range .....                   |                 |
| Lead Temperature (soldering, 10s) (Note 1) .....  |                 |
|                                                   |                 |

**Note 1:** Maximum reflow temperature for the MAX203 and MAX205 is +225°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

(MAX202/MAX204/MAX206/MAX208/MAX211/MAX213: V<sub>CC</sub> = +5V ±10%; MAX200/MAX203/MAX205/MAX207: V<sub>CC</sub> = +5V ±5%, C1–C4 = 0.1µF; MAX201/MAX209: V<sub>CC</sub> = +5V ±10%, V<sub>+</sub> = +9.0V to +13.2V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted.)

| PARAMETER                            | CONDITIONS                                                                    | MIN                                   | TYP | MAX | UNITS |
|--------------------------------------|-------------------------------------------------------------------------------|---------------------------------------|-----|-----|-------|
| Output-Voltage Swing                 | All transmitter outputs loaded with 3kΩ to ground                             | ±5                                    | ±8  |     | V     |
| V <sub>CC</sub> Power-Supply Current | No load, T <sub>A</sub> = +25°C                                               | MAX202, MAX203                        |     | 8   | 15    |
|                                      |                                                                               | MAX200, MAX204–MAX208, MAX211, MAX213 |     | 11  | 20    |
|                                      |                                                                               | MAX201, MAX209                        |     | 0.4 | 1     |
| V <sub>+</sub> Power-Supply Current  | No load                                                                       | MAX201                                |     | 5   | 10    |
|                                      |                                                                               | MAX209                                |     | 7   | 15    |
| Shutdown Supply Current              | Figure 1, T <sub>A</sub> = +25°C                                              | MAX200, MAX205, MAX206, MAX211        |     | 1   | 10    |
|                                      |                                                                               | MAX213                                |     | 15  | 50    |
| Input Logic Threshold Low            | T <sub>IN</sub> , $\overline{\text{EN}}$ , SHDN, EN, $\overline{\text{SHDN}}$ |                                       |     | 0.8 | V     |
| Input Logic Threshold High           | T <sub>IN</sub>                                                               | 2.0                                   |     |     | V     |
|                                      | $\overline{\text{EN}}$ , SHDN, EN, $\overline{\text{SHDN}}$                   | 2.4                                   |     |     |       |
| Logic Pullup Current                 | T <sub>IN</sub> = 0V                                                          |                                       | 15  | 200 | µA    |
| RS-232 Input-Voltage Operating Range |                                                                               | -30                                   |     | +30 | V     |

# MAX200–MAX209/ MAX211/MAX213

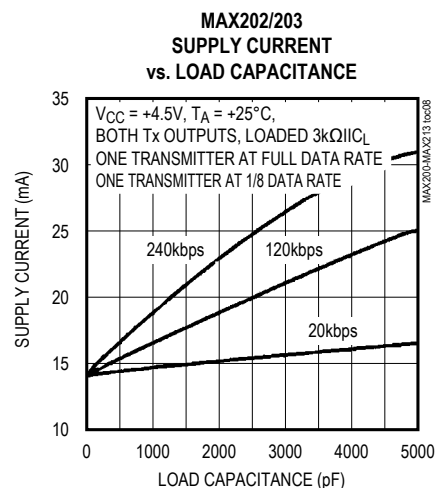
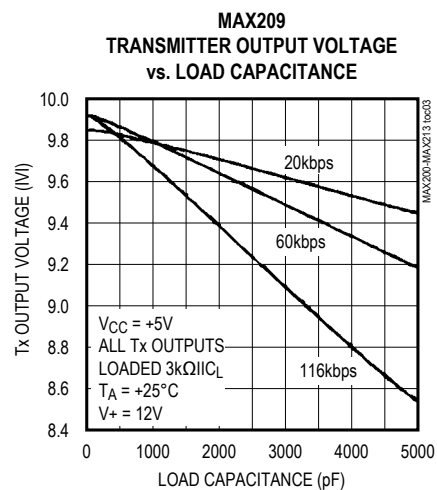
+5V, RS-232 Transceivers  
with 0.1μF External Capacitors

## Electrical Characteristics (continued)

(MAX202/MAX204/MAX206/MAX208/MAX211/MAX213:  $V_{CC} = +5V \pm 10\%$ ; MAX200/MAX203/MAX205/MAX207:  $V_{CC} = +5V \pm 5\%$ ,  $C1$ – $C4 = 0.1\mu F$ ; MAX201/MAX209:  $V_{CC} = +5V \pm 10\%$ ,  $V+ = +9.0V$  to  $+13.2V$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted.)

| PARAMETER                           | CONDITIONS                                                                                                                                        |                                        | MIN | TYP  | MAX | UNITS |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-----|------|-----|-------|
| Receiver Input Threshold Low        | V <sub>CC</sub> = +5V, T <sub>A</sub> = +25°C                                                                                                     | Active mode                            | 0.8 | 1.2  |     | V     |
|                                     |                                                                                                                                                   | Shutdown mode, MAX213, R4, R5          | 0.6 | 1.5  |     |       |
| Receiver Input Threshold High       | V <sub>CC</sub> = +5V, T <sub>A</sub> = +25°C                                                                                                     | Active mode                            |     | 1.7  | 2.4 | V     |
|                                     |                                                                                                                                                   | Shutdown mode, MAX213, R4, R5          |     | 1.5  | 2.4 |       |
| RS-232 Input Hysteresis             | V <sub>CC</sub> = +5V, no hysteresis in shutdown                                                                                                  |                                        | 0.2 | 0.5  | 1.0 | V     |
| RS-232 Input Resistance             | V <sub>CC</sub> = +5V, T <sub>A</sub> = +25°C                                                                                                     |                                        | 3   | 5    | 7   | kΩ    |
| TTL/CMOS Output-Voltage Low         | I <sub>OUT</sub> = 3.2mA                                                                                                                          | MAX201, MAX202, MAX203                 | 0.4 |      |     | V     |
|                                     | I <sub>OUT</sub> = 1.6mA                                                                                                                          | All others                             |     |      |     |       |
| TTL/CMOS Output-Voltage High        | I <sub>OUT</sub> = 1.0mA                                                                                                                          |                                        | 3.5 |      |     | V     |
| TTL/CMOS Output Leakage Current     | EN = V <sub>CC</sub> , EN = 0V, 0 ≤ R <sub>OUT</sub> ≤ V <sub>CC</sub>                                                                            |                                        |     | 0.05 | ±10 | μA    |
| Output Enable Time                  | Figure 2                                                                                                                                          | MAX205, MAX206, MAX209, MAX211, MAX213 |     | 600  |     | ns    |
| Output Disable Time                 | Figure 2                                                                                                                                          | MAX205, MAX206, MAX209, MAX211, MAX213 |     | 200  |     | ns    |
| Receiver Propagation Delay          | SHDN = 0V, R4, R5                                                                                                                                 | MAX213                                 |     | 4    | 40  | μs    |
|                                     | SHDN = V <sub>CC</sub>                                                                                                                            |                                        |     | 0.5  | 10  |       |
|                                     | MAX200–MAX211                                                                                                                                     |                                        |     | 0.5  | 10  |       |
| Transmitter Output Resistance       | V <sub>CC</sub> = V+ = V- = 0V, V <sub>OUT</sub> = ±2V                                                                                            |                                        | 300 |      |     | Ω     |
| Transition Region 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 to +3V | MAX200, MAX202–MAX211, MAX213          | 3   | 5.5  | 30  | V/μs  |
|                                     |                                                                                                                                                   | MAX201                                 |     | 4    | 30  |       |
| RS-232 Output Short-Circuit Current |                                                                                                                                                   |                                        |     | ±10  | ±60 | mA    |
| Maximum Data Rate                   | R <sub>L</sub> = 3kΩ to 7kΩ, C <sub>L</sub> = 50pF to 1000pF, one transmitter                                                                     |                                        | 120 |      |     | kbps  |

## Typical Operating Characteristics



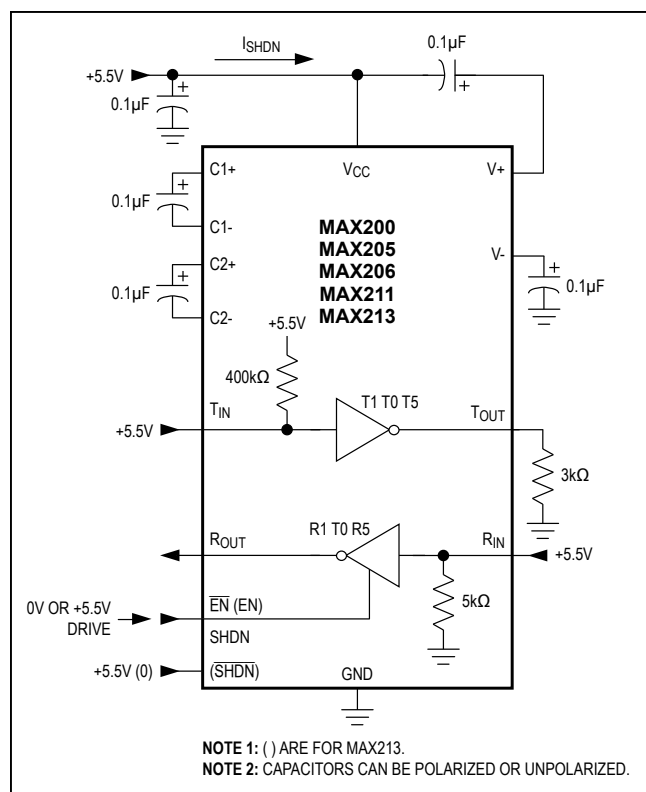


Figure 1. Shutdown Current Test Circuit

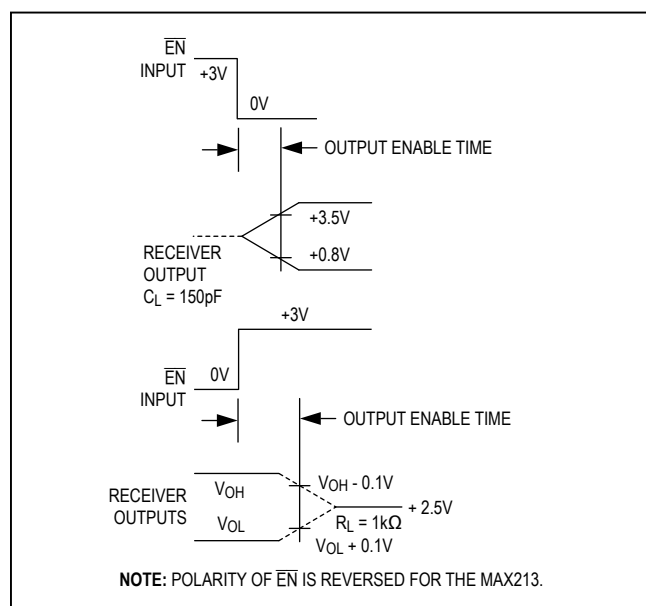


Figure 2. Receiver Output Enable and Disable Timing

## Detailed Description

The MAX200–MAX209/MAX211/MAX213 consist of three sections: charge-pump voltage converters, drivers (transmitters), and receivers. Each section is described in detail.

### +5V to ±10V Dual Charge-Pump Voltage Converter

The +5V to ±10V conversion is performed by two charge-pump voltage converters (Figure 4). The first uses capacitor C1 to double +5V to +10V, storing +10V on the V+ output filter capacitor, C3. The second chargepump voltage converter uses capacitor C2 to invert +10V to -10V, storing -10V on the V- output filter capacitor, C4.

The MAX201 and MAX209 include only the V+ to Vcharge pump, and are intended for applications that have a VCC = +5V supply and a V+ supply in the +9V to +13.2V range.

In shutdown mode, V+ is internally connected to VCC by a 1kΩ pulldown resistor and V- is internally connected to ground by a 1kΩ pullup resistor.

### RS-232 Drivers

When VCC = +5V, the typical driver output-voltage swing is ±8V when loaded with a nominal 5kΩ RS-232 receiver. The output swing is guaranteed to meet the EIA/TIA-232E and V.28 specifications, which call for ±5V minimum output levels under worst-case conditions. These include a minimum 3kΩ load, VCC = +4.5V, and the maximum operating temperature. The open-circuit output-voltage swing ranges from (V+ - 0.6V) to V-.

Input thresholds are both CMOS and TTL compatible. The inputs of unused drivers can be left unconnected since 400kΩ pullup resistors to VCC are included onchip. Since all drivers invert, the pullup resistors force the outputs of unused drivers low. The input pullup resistors typically source 15μA; therefore, the driver inputs should be driven high or open circuited to minimize power-supply current in shutdown mode.

When in low-power shutdown mode, the driver outputs are turned off and their leakage current is less than 1mA, even if the transmitter output is backdriven between 0V and (VCC + 6V). Below -0.5V, the transmitter output is diode clamped to ground with a 1kΩ series impedance. The transmitter output is also zener clamped to approximately (VCC + 6V), with a 1kΩ series impedance.

## MAX200–MAX209/ MAX211/MAX213

## +5V, RS-232 Transceivers with 0.1μF External Capacitors

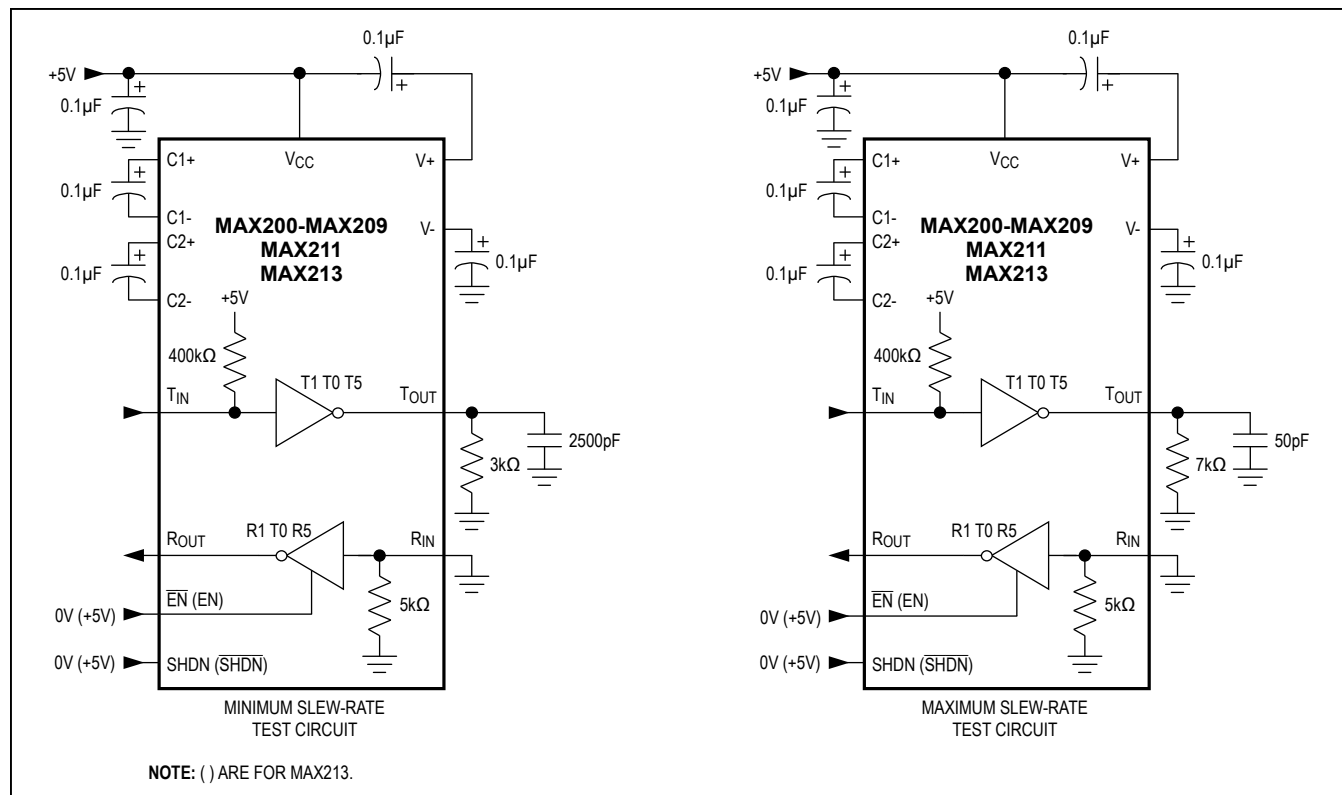


Figure 3. Transition Slew-Rate Test Circuit

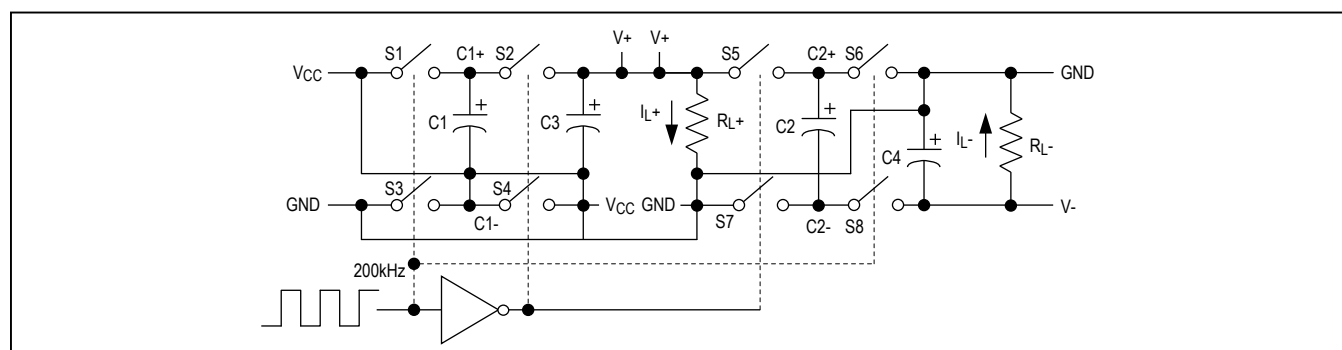


Figure 4. Dual Charge-Pump Diagram

### RS-232 Receivers

The receivers convert RS-232 signals to CMOS logic output levels. Receiver outputs are inverting, maintaining compatibility with driver outputs. The guaranteed receiver input thresholds of +0.8V and +2.4V are significantly tighter than the  $\pm 3.0$ V threshold required by the EIA/TIA-232E specification. This allows receiver inputs to respond to TTL/CMOS logic levels and improves noise margin for RS-232 levels.

The MAX200–MAX209/MAX211/MAX213 guaranteed +0.8V threshold (+0.6V in shutdown for the MAX213) ensures that receivers shorted to ground have a logic 1 output. Also, the 5kΩ input resistance to ground ensures that a receiver with its input left open also has a logic 1 output.

Receiver inputs have approximately +0.5V hysteresis. This provides clean output transitions, even with slow rise and fall time input signals with moderate amounts of noise and ringing. In shutdown, the MAX213 receivers R4 and R5 have no hysteresis.

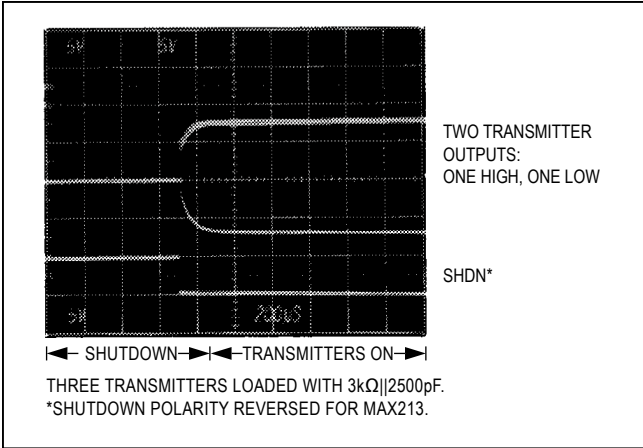


Figure 5. Transmitter Outputs When Exiting Shutdown

### Shutdown and Enable Control

In shutdown mode, the MAX200/MAX205/MAX206/MAX211/MAX213 charge pumps are turned off, V+ is pulled down to V<sub>CC</sub>, V- is pulled to ground, and the transmitter outputs are disabled. This reduces supply current

typically to 1μA (15μA for the MAX213). The time required to exit shutdown is 1ms, as shown in Figure 5.

All receivers except R4 and R5 on the MAX213 are put into a high-impedance state in shutdown mode. The MAX213's R4 and R5 receivers still function in shutdown mode. These two receivers are useful for monitoring external activity while maintaining minimal power consumption.

The enable control is used to put the receiver outputs into a high-impedance state, so that the receivers can be connected directly to a three-state bus. It has no effect on the RS-232 drivers or on the charge pumps.

### MAX213 Receiver Operation in Shutdown

During normal operation, the MAX213's receiver propagation delay is typically 1μs. When entering shutdown with receivers active, R4 and R5 are not valid until 80μs after  $\overline{\text{SHDN}}$  is driven low. In shutdown mode, propagation delays increase to 4μs for a high-to-low or a low-to-high transition.

When exiting shutdown, all receiver outputs are invalid until the charge pumps reach nominal values (< 2ms when using 0.1μF capacitors).

Table 1a. MAX200 Control Pin Configurations

| SHDN | OPERATION STATUS | TRANSMITTERS T1–T5 |
|------|------------------|--------------------|
| 0    | Normal Operation | All Active         |
| 1    | Shutdown         | All High-Z         |

Table 1b. MAX205/MAX206/MAX211 Control Pin Configurations

| SHDN | $\overline{\text{EN}}$ | OPERATION STATUS | TRANSMITTERS T1–T5 | RECEIVERS R1–R5 |
|------|------------------------|------------------|--------------------|-----------------|
| 0    | 0                      | Normal Operation | All Active         | All Active      |
| 0    | 1                      | Normal Operation | All Active         | All High-Z      |
| 1    | 0                      | Shutdown         | All High-Z         | All High-Z      |

Table 1c. MAX213 Control Pin Configurations

| SHDN | EN | OPERATION STATUS | TRANSMITTERS T1–T4 | RECEIVERS  |         |
|------|----|------------------|--------------------|------------|---------|
|      |    |                  |                    | R1, R2, R3 | R4, R5  |
| 0    | 0  | Shutdown         | All High-Z         | High-Z     | High-Z  |
| 0    | 1  | Shutdown         | All High-Z         | High-Z     | Active* |
| 1    | 0  | Normal Operation | All Active         | High-Z     | High-Z  |
| 1    | 1  | Normal Operation | All Active         | Active     | Active  |

\*Active = active with reduced performance.

## Applications Information

### Capacitor Selection

The type of capacitor used is not critical for proper operation. Ceramic capacitors are suggested. To ensure proper RS-232 signal levels over temperature when using 0.1μF capacitors, make sure the capacitance value does not degrade excessively as the temperature varies. If in doubt, use capacitors with a larger nominal value. Also observe the capacitors' ESR value over temperature, since it influences the amount of ripple on V+ and V-. To reduce the output impedance at V+ and V-, use larger capacitors (up to 10μF). If polarized capacitors are used, obey the polarities shown in Figure 1 and the pin configurations.

### Driving Multiple Receivers

Each transmitter is designed to drive a single receiver. Transmitters can be paralleled to drive multiple receivers.

### Driver Outputs When Exiting Shutdown

Figure 5 shows two driver outputs exiting shutdown. As they become active, the two driver outputs go to opposite RS-232 levels (one driver input is high, the other is low). Each driver is loaded with 3kΩ in parallel with 2500pF. The driver outputs display no ringing or undesirable transients as they come out of shutdown.

### Power-Supply Decoupling

In applications that are sensitive to power-supply noise, decouple V<sub>CC</sub> to ground with a capacitor of the same value as the charge-pump capacitors.

### V+ and V- as Power Supplies

A small amount of power can be drawn from V+ and V-, although this reduces noise margins.

### Power Supplies for MAX201/MAX209

If at power-up the V+ supply rises after the V<sub>CC</sub> supply, place a diode (e.g., 1N914) in series with the V+ supply.

**Table 2. Summary of EIA/TIA-232E, V.28 Specifications**

| PARAMETER                                    | CONDITION                                           | EIA/TIA-232E, V.28 SPECIFICATION |
|----------------------------------------------|-----------------------------------------------------|----------------------------------|
| Driver Output Voltage: 0 Level               | 3kΩ to 7kΩ load                                     | +5.0V to +15V                    |
| Driver Output Voltage: 1 Level               | 3kΩ to 7kΩ load                                     | -5.0V to -15V                    |
| Output Level, Maximum                        | No load                                             | ±25V                             |
| Data Rate                                    | 3kΩ ≤ R <sub>L</sub> ≤ 7kΩ, C <sub>L</sub> ≤ 2500pF | Up to 20kbps                     |
| Receiver Input Voltage: 0 Level              | —                                                   | +3.0V to +15V                    |
| Receiver Input Voltage: 1 Level              | —                                                   | -3.0V to -15V                    |
| Input Level, Maximum                         | —                                                   | ±25V                             |
| Instantaneous Slew Rate, Maximum             | 3kΩ ≤ R <sub>L</sub> ≤ 7kΩ, C <sub>L</sub> ≤ 2500pF | 30V/μs                           |
| Driver Output Short-Circuit Current, Maximum | —                                                   | 100mA                            |
| Transition Rate on Driver Output             | V.28                                                | 1ms or 3% of the period          |
|                                              | EIA/TIA-232E                                        | 4% of the period                 |
| Driver Output Resistance                     | -2V < V <sub>OUT</sub> < +2V                        | 300Ω                             |

**Table 3. DB9 Cable Connections Commonly Used for EIA/TIA-232E and V.24 Asynchronous Interfaces**

| PIN | NAME                                                                 | CONNECTION                  |
|-----|----------------------------------------------------------------------|-----------------------------|
| 1   | Received Line Signal Detector, sometimes called Carrier Detect (DCD) | Handshake from DCE          |
| 2   | Receive Data (RD)                                                    | Data from DCE               |
| 3   | Transmit Data (TD)                                                   | Data from DTE               |
| 4   | Data Terminal Ready                                                  | Handshake from DTE          |
| 5   | Signal Ground                                                        | Reference point for signals |
| 6   | Data Set Ready (DSR)                                                 | Handshake from DCE          |
| 7   | Request to Send (RTS)                                                | Handshake from DTE          |
| 8   | Clear to Send (CTS)                                                  | Handshake from DCE          |
| 9   | Ring Indicator                                                       | Handshake from DCE          |

**TOP VIEW**

MAX200

**DIP/SO**

**Pinout:**

| Pin | Function | Pin | Function |
|-----|----------|-----|----------|
| 1   | T3OUT    | 20  | T4OUT    |
| 2   | T1OUT    | 19  | T5IN     |
| 3   | T2OUT    | 18  | N.C.     |
| 4   | T2IN     | 17  | SHND     |
| 5   | T1IN     | 16  | T5OUT    |
| 6   | GND      | 15  | T4IN     |
| 7   | VCC      | 14  | T3IN     |
| 8   | C1+      | 13  | V-       |
| 9   | V+       | 12  | C2-      |
| 10  | C1-      | 11  | C2+      |

**Internal Circuitry:**

The MAX200 contains two voltage doublers and five inverters.

- Voltage Doublers:**
  - +5V TO +10V VOLTAGE DOUBLER:** Input C1+ (pin 8) is connected to a 0.1μF capacitor to +6.3V. The output V+ (pin 9) is connected to a 0.1μF capacitor to +6.3V.
  - +10V TO -10V VOLTAGE INVERTER:** Input C2+ (pin 11) is connected to a 0.1μF capacitor to +16V. The output V- (pin 13) is connected to a 0.1μF capacitor to +16V.
- Inverters:**
  - T1:** Input T1IN (pin 5) is connected to a 400kΩ resistor to +5V. Output T1OUT (pin 2).
  - T2:** Input T2IN (pin 4) is connected to a 400kΩ resistor to +5V. Output T2OUT (pin 3).
  - T3:** Input T3IN (pin 14) is connected to a 400kΩ resistor to +5V. Output T3OUT (pin 1).
  - T4:** Input T4IN (pin 15) is connected to a 400kΩ resistor to +5V. Output T4OUT (pin 20).
  - T5:** Input T5IN (pin 19) is connected to a 400kΩ resistor to +5V. Output T5OUT (pin 16).

**MAX200**

**Pinout:**

| Pin | Function | Pin | Function |
|-----|----------|-----|----------|
| 1   | T3OUT    | 20  | T4OUT    |
| 2   | T1OUT    | 19  | T5IN     |
| 3   | T2OUT    | 18  | N.C.     |
| 4   | T2IN     | 17  | SHND     |
| 5   | T1IN     | 16  | T5OUT    |
| 6   | GND      | 15  | T4IN     |
| 7   | VCC      | 14  | T3IN     |
| 8   | C1+      | 13  | V-       |
| 9   | V+       | 12  | C2-      |
| 10  | C1-      | 11  | C2+      |

**Internal Circuitry:**

The MAX200 contains two voltage doublers and five inverters.

- Voltage Doublers:**
  - +5V TO +10V VOLTAGE DOUBLER:** Input C1+ (pin 8) is connected to a 0.1μF capacitor to +6.3V. The output V+ (pin 9) is connected to a 0.1μF capacitor to +6.3V.
  - +10V TO -10V VOLTAGE INVERTER:** Input C2+ (pin 11) is connected to a 0.1μF capacitor to +16V. The output V- (pin 13) is connected to a 0.1μF capacitor to +16V.
- Inverters:**
  - T1:** Input T1IN (pin 5) is connected to a 400kΩ resistor to +5V. Output T1OUT (pin 2).
  - T2:** Input T2IN (pin 4) is connected to a 400kΩ resistor to +5V. Output T2OUT (pin 3).
  - T3:** Input T3IN (pin 14) is connected to a 400kΩ resistor to +5V. Output T3OUT (pin 1).
  - T4:** Input T4IN (pin 15) is connected to a 400kΩ resistor to +5V. Output T4OUT (pin 20).
  - T5:** Input T5IN (pin 19) is connected to a 400kΩ resistor to +5V. Output T5OUT (pin 16).

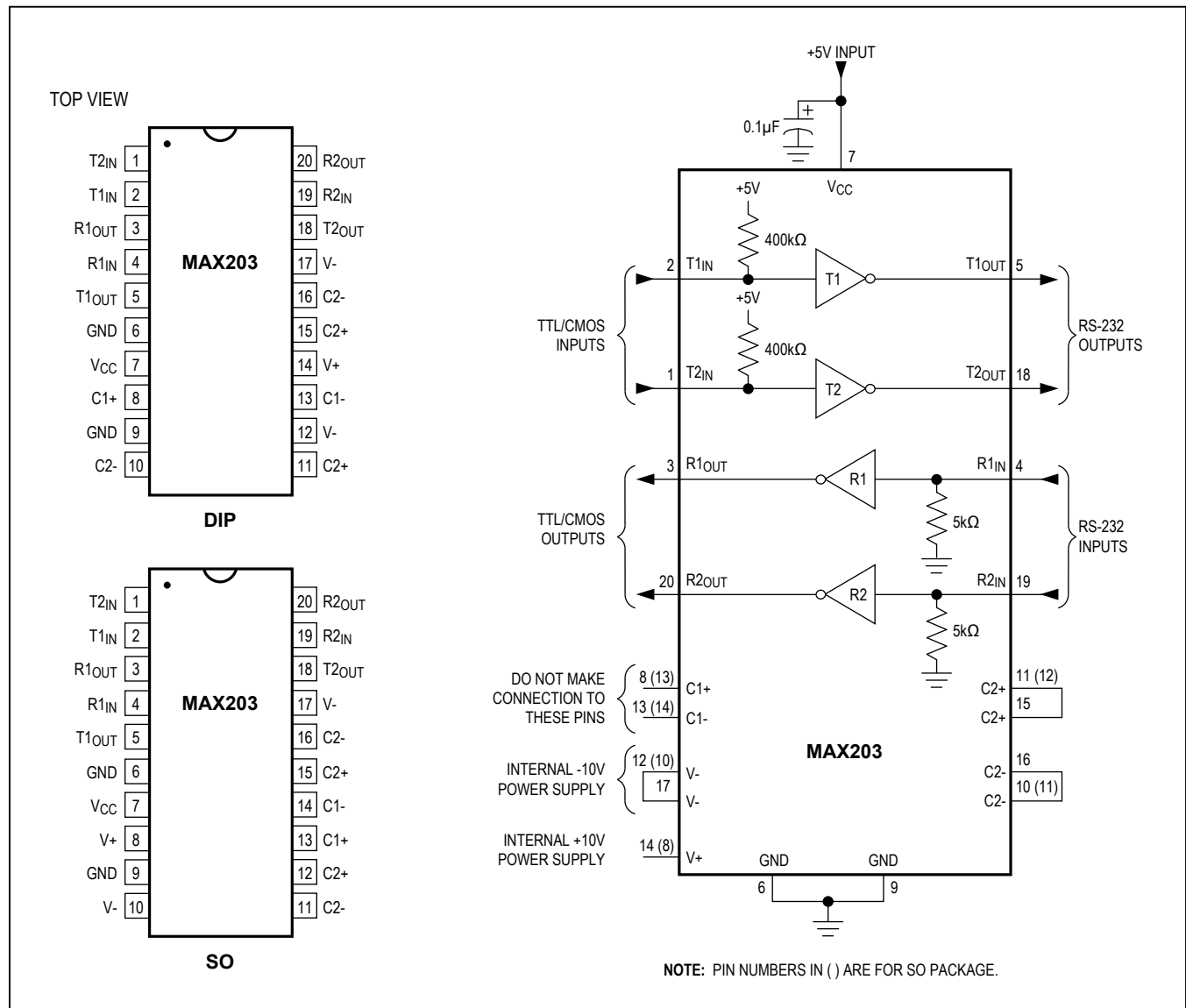
## MAX201 Pin Configurations/Typical Operating Circuit



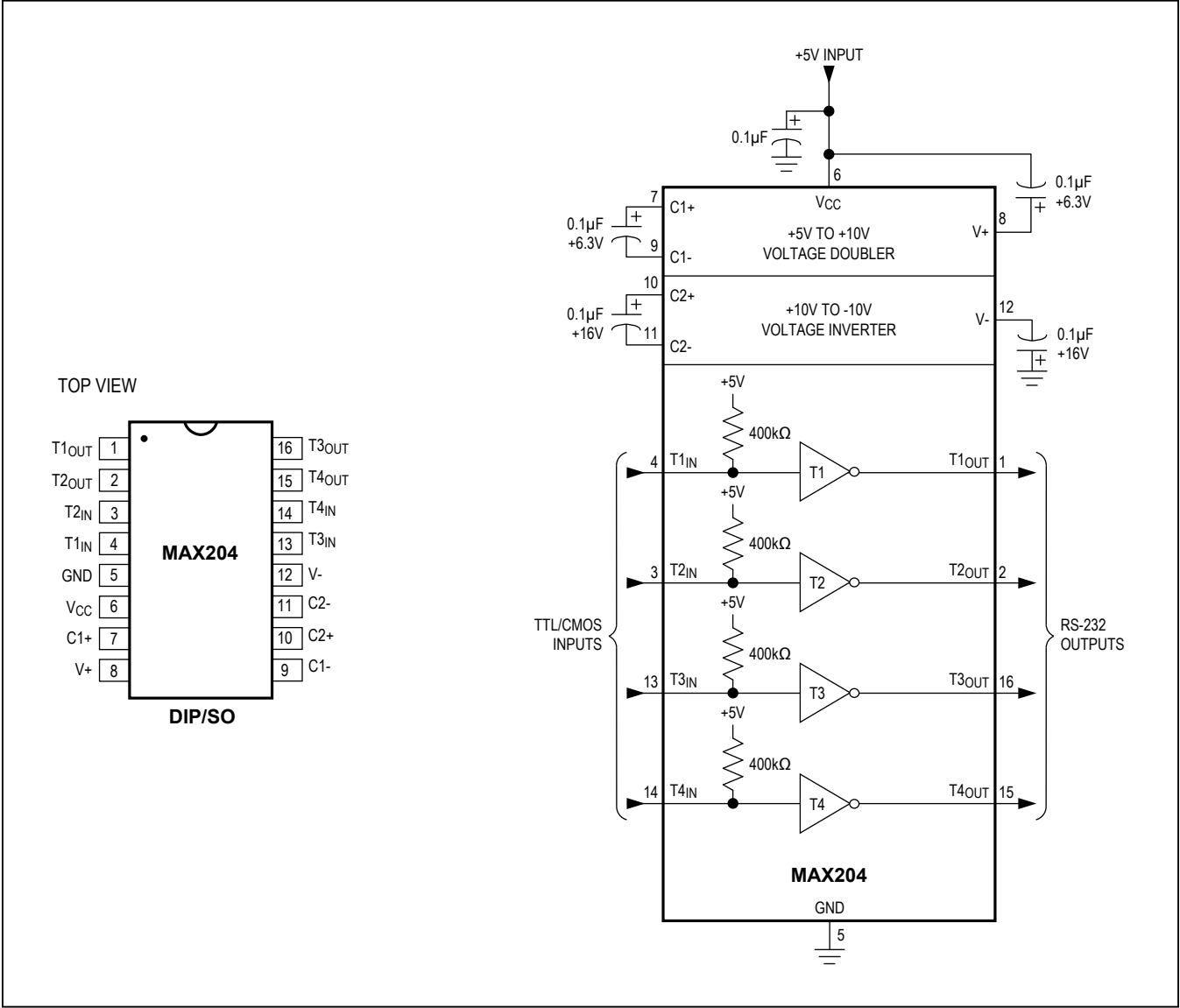
## MAX202 Pin Configuration/Typical Operating Circuit



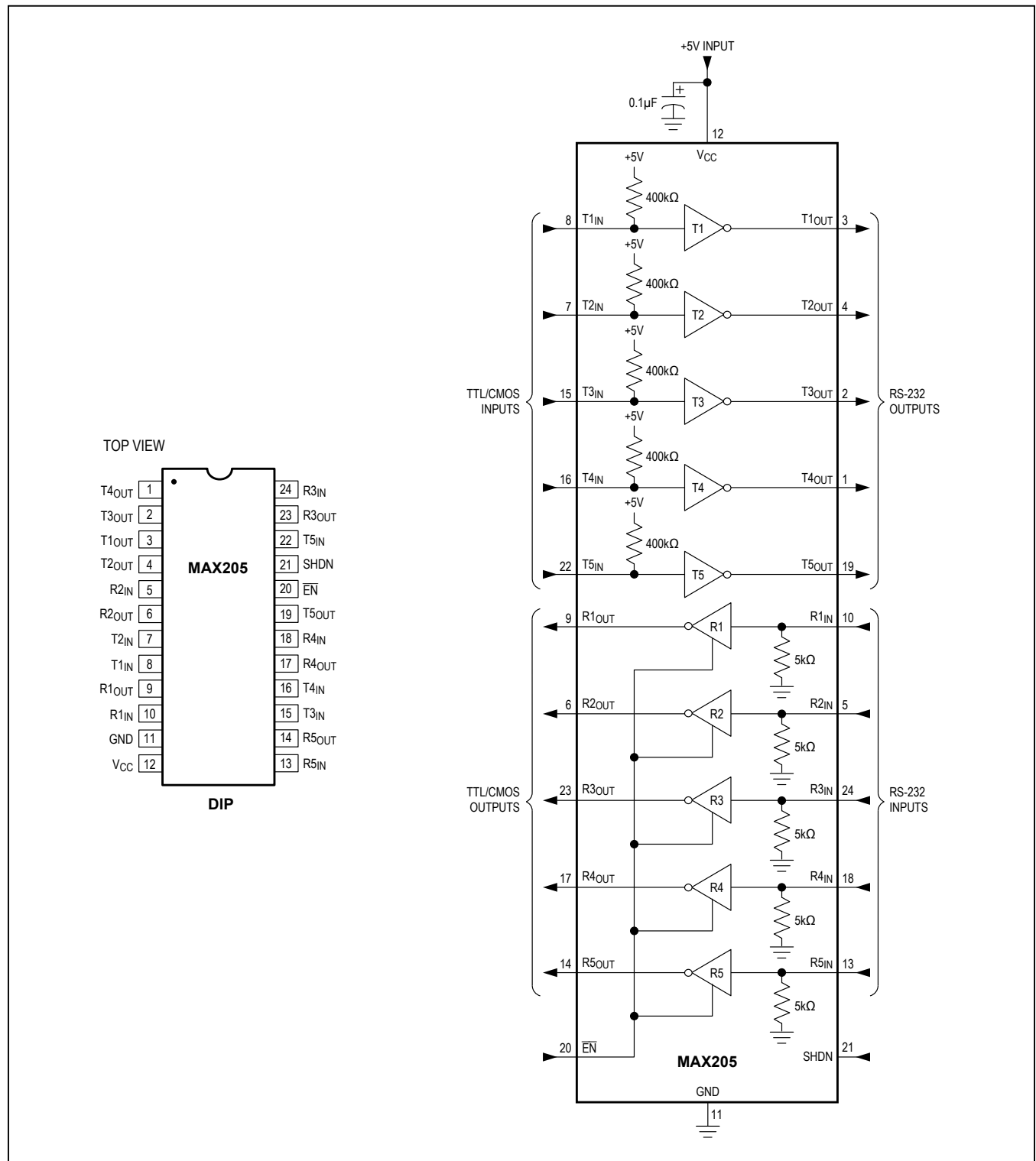
## MAX203 Pin Configurations/Typical Operating Circuit



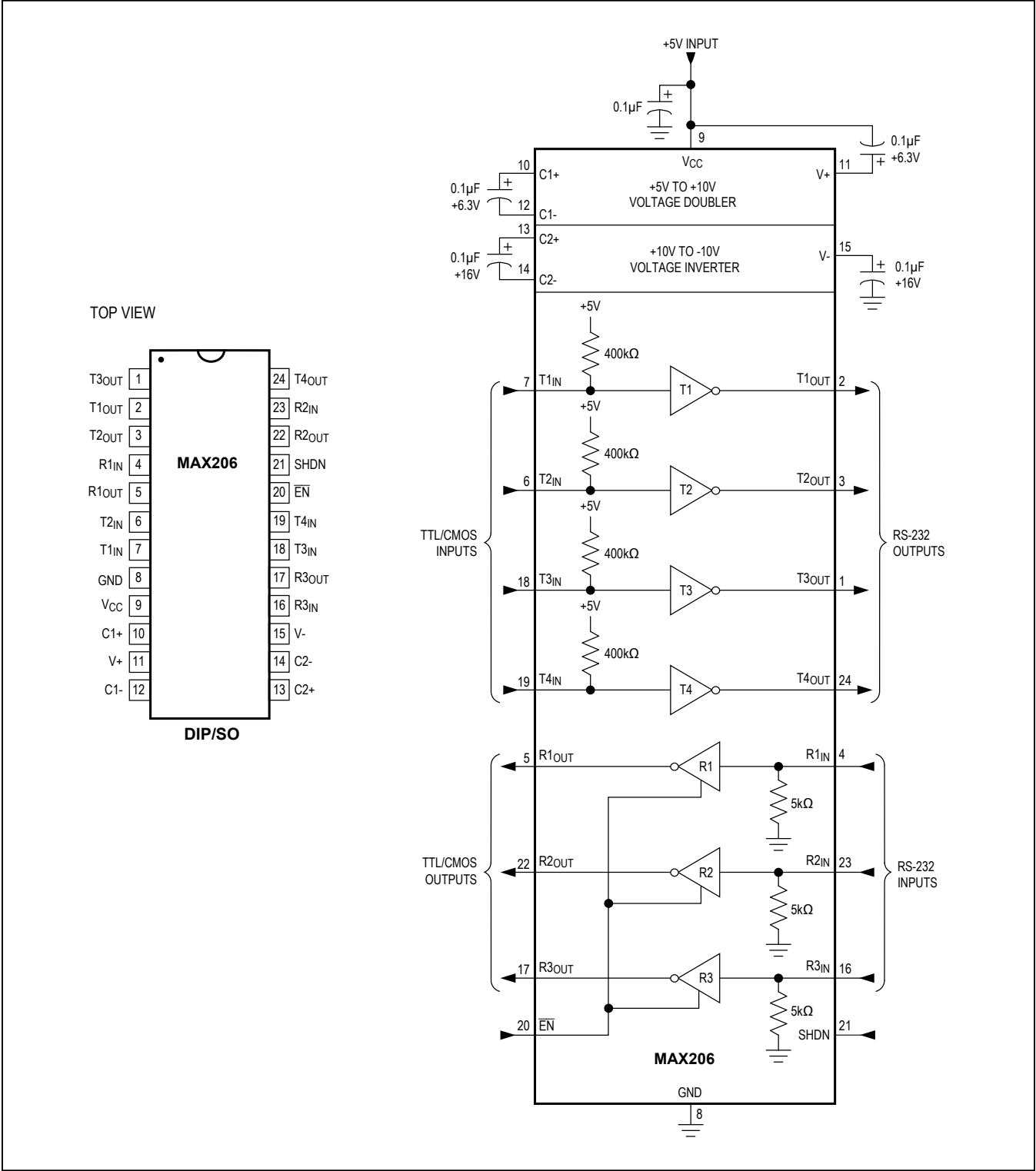
MAX204 Pin Configuration/Typical Operating Circuit



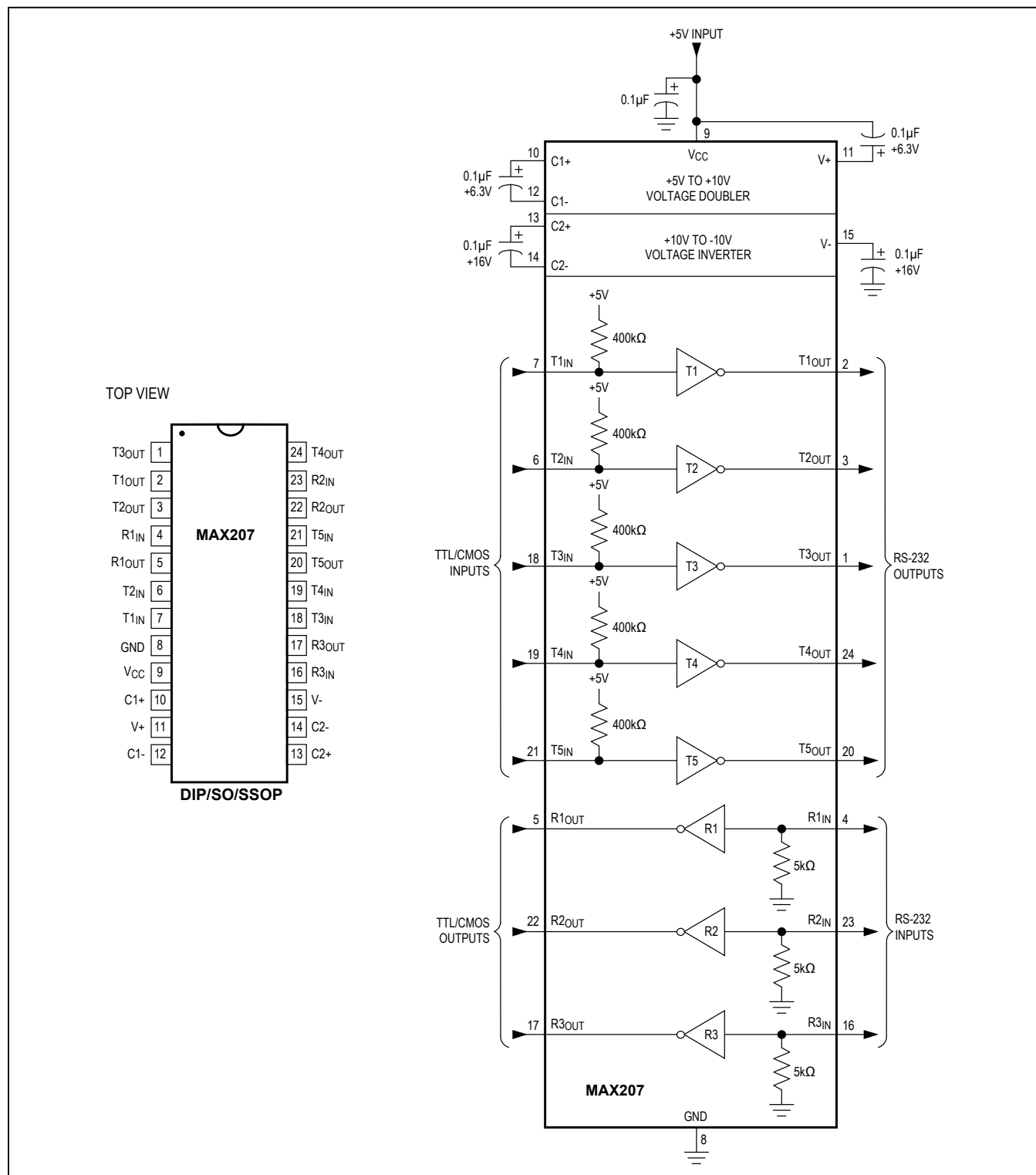
## MAX205 Pin Configuration/Typical Operating Circuit



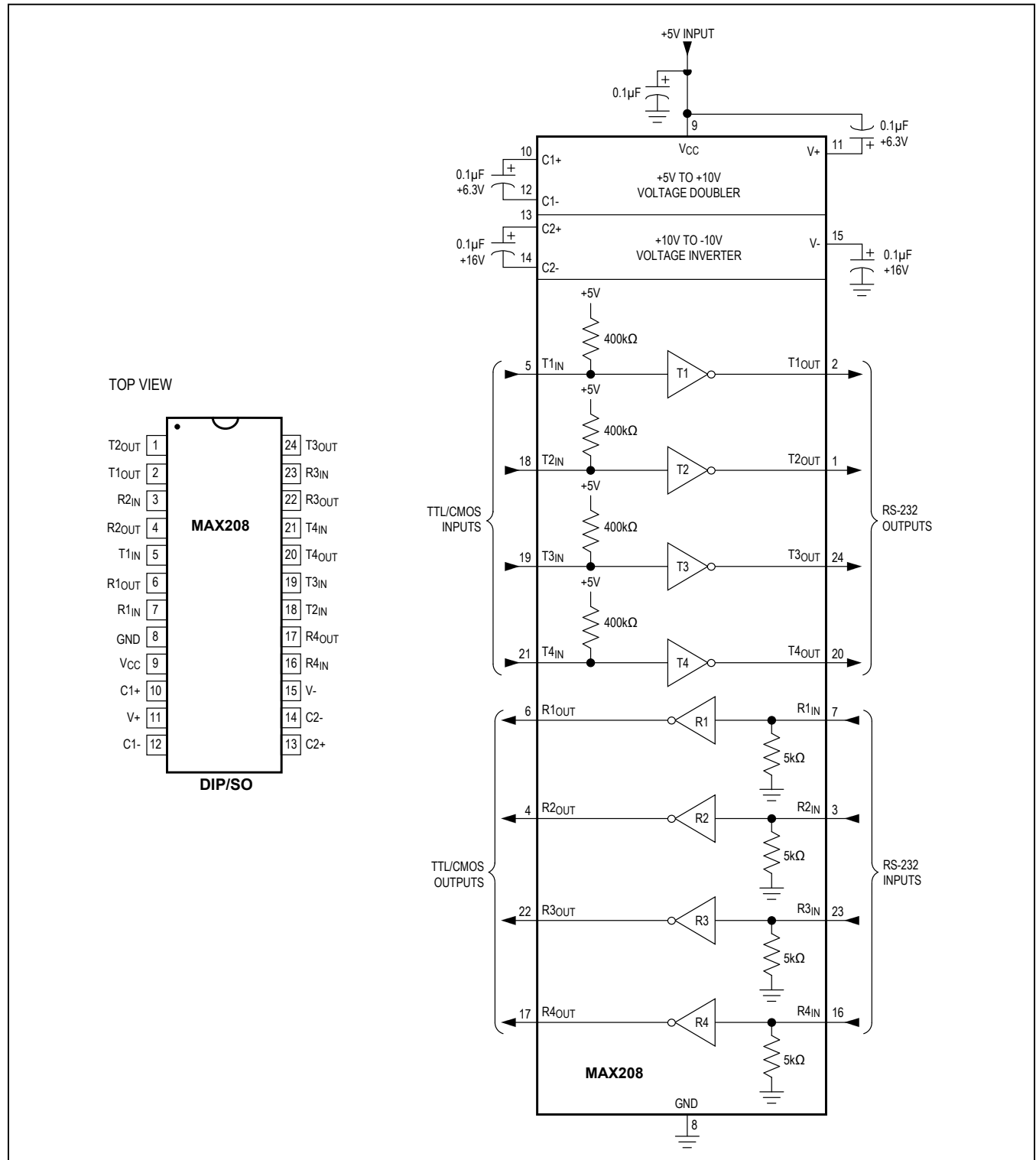
MAX206 Pin Configuration/Typical Operating Circuit



## MAX207 Pin Configuration/Typical Operating Circuit

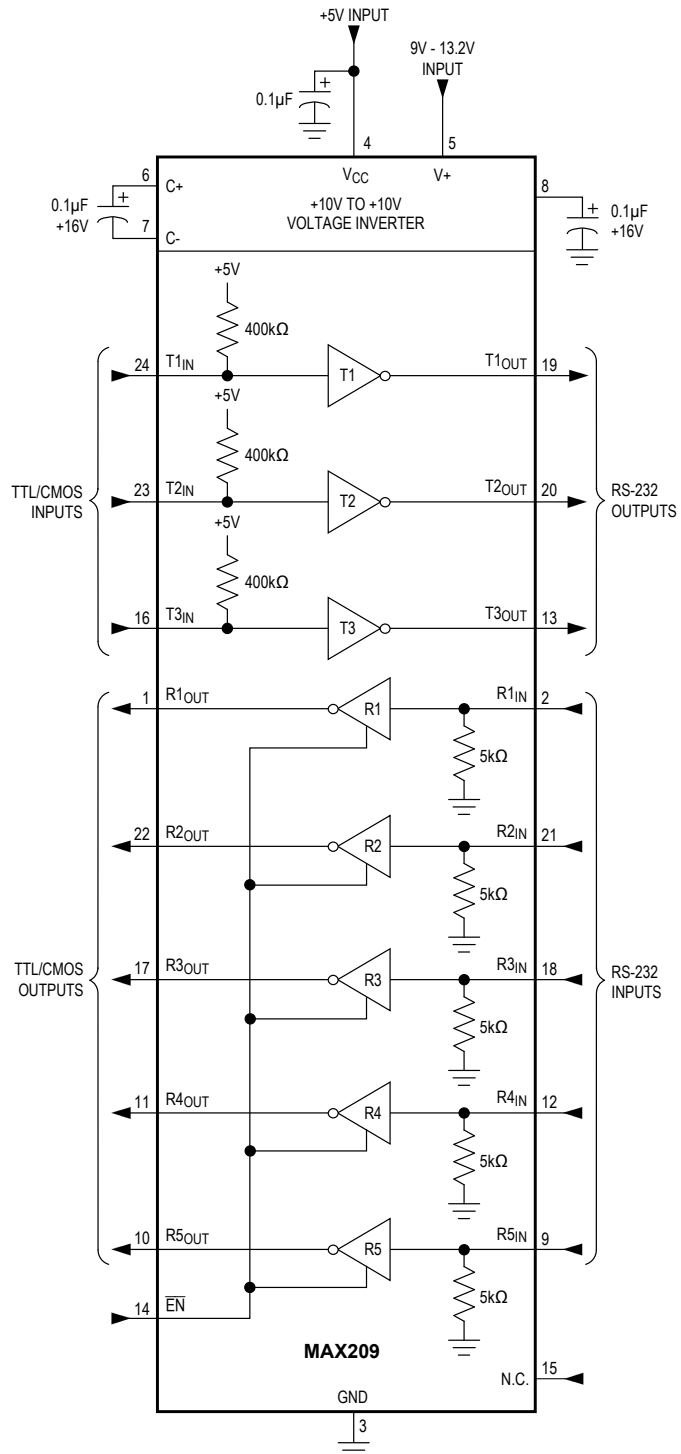
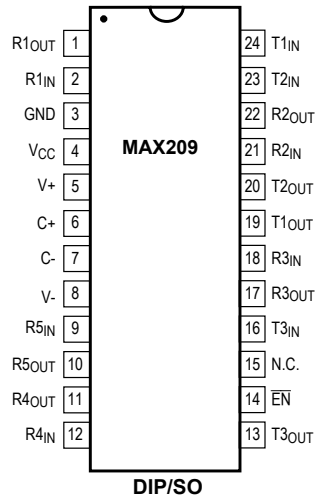


## MAX208 Pin Configuration/Typical Operating Circuit

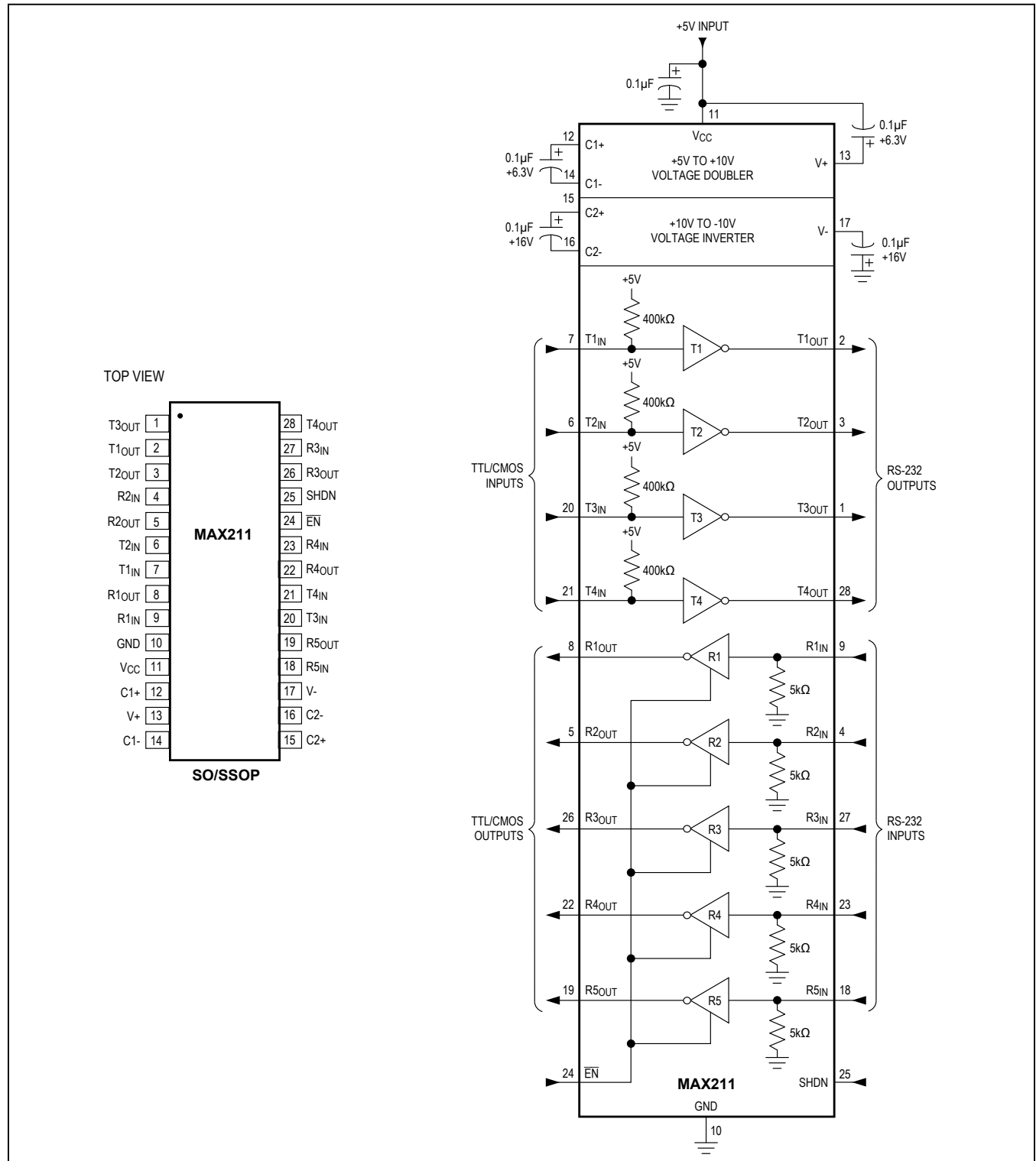


## MAX209 Pin Configuration/Typical Operating Circuit

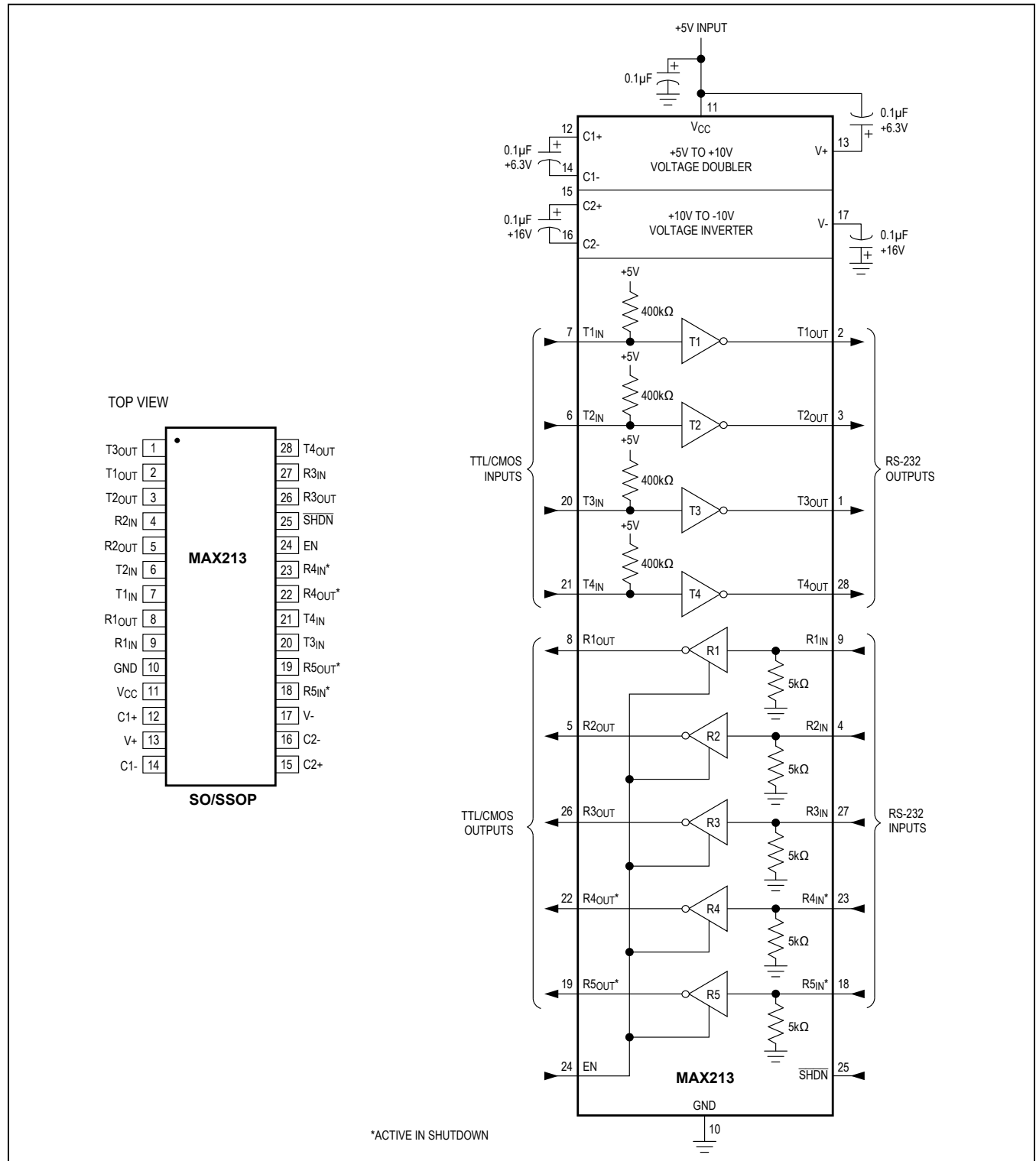
TOP VIEW



## MAX211 Pin Configuration/Typical Operating Circuit



## MAX213 Pin Configuration/Typical Operating Circuit



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## Ordering Information

| PART              | TEMP RANGE     | PIN-PACKAGE           |
|-------------------|----------------|-----------------------|
| <b>MAX200</b> CPP | 0°C to +70°C   | 20 Plastic DIP        |
| MAX200CWP         | 0°C to +70°C   | 20 Wide SO            |
| MAX200EPP         | -40°C to +85°C | 20 Plastic DIP        |
| MAX200EWP         | -40°C to +85°C | 20 Wide SO            |
| <b>MAX201</b> CPD | 0°C to +70°C   | 14 Plastic DIP        |
| MAX201CWE         | 0°C to +70°C   | 16 Wide SO            |
| MAX201C/D         | 0°C to +70°C   | Dice*                 |
| MAX201EPD         | -40°C to +85°C | 14 Plastic DIP        |
| MAX201EWE         | -40°C to +85°C | 16 Wide SO            |
| <b>MAX202</b> CPE | 0°C to +70°C   | 16 Plastic DIP        |
| MAX202CSE         | 0°C to +70°C   | 16 Narrow SO          |
| MAX202CWE         | 0°C to +70°C   | 16 Wide SO            |
| MAX202C/D         | 0°C to +70°C   | Dice*                 |
| MAX202EPE         | -40°C to +85°C | 16 Plastic DIP        |
| MAX202ESE         | -40°C to +85°C | 16 Narrow SO          |
| MAX202EWE         | -40°C to +85°C | 16 Wide SO            |
| <b>MAX203</b> CPP | 0°C to +70°C   | 20 Plastic DIP        |
| MAX203CWP         | 0°C to +70°C   | 20 Wide SO            |
| MAX203EPP         | -40°C to +85°C | 20 Plastic DIP        |
| MAX203EWP         | -40°C to +85°C | 20 Wide SO            |
| <b>MAX204</b> CPE | 0°C to +70°C   | 16 Plastic DIP        |
| MAX204CWE         | 0°C to +70°C   | 16 Wide SO            |
| MAX204C/D         | 0°C to +70°C   | Dice*                 |
| MAX204EPE         | -40°C to +85°C | 16 Plastic DIP        |
| MAX204EWE         | -40°C to +85°C | 16 Wide SO            |
| <b>MAX205</b> CPG | 0°C to +70°C   | 24 Wide Plastic DIP   |
| MAX205EPG         | -40°C to +85°C | 24 Wide Plastic DIP   |
| <b>MAX206</b> CNG | 0°C to +70°C   | 24 Narrow Plastic DIP |
| MAX206CWG         | 0°C to +70°C   | 24 Wide SO            |
| MAX206CAG         | 0°C to +70°C   | 24 SSOP               |
| MAX206ENG         | -40°C to +85°C | 24 Narrow Plastic DIP |

| PART              | TEMP RANGE     | PIN-PACKAGE           |
|-------------------|----------------|-----------------------|
| MAX206EWG         | -40°C to +85°C | 24 Wide SO            |
| MAX206EAG         | -40°C to +85°C | 24 SSOP               |
| <b>MAX207</b> CNG | 0°C to +70°C   | 24 Narrow Plastic DIP |
| MAX207CWG         | 0°C to +70°C   | 24 Wide SO            |
| MAX207CAG         | 0°C to +70°C   | 24 SSOP               |
| MAX207ENG         | -40°C to +85°C | 24 Narrow Plastic DIP |
| MAX207EWG         | -40°C to +85°C | 24 Wide SO            |
| MAX207EAG         | -40°C to +85°C | 24 SSOP               |
| <b>MAX208</b> CNG | 0°C to +70°C   | 24 Narrow Plastic DIP |
| MAX208CWG         | 0°C to +70°C   | 24 Wide SO            |
| MAX208CAG         | 0°C to +70°C   | 24 SSOP               |
| MAX208C/D         | 0°C to +70°C   | Dice*                 |
| MAX208ENG         | -40°C to +85°C | 24 Narrow Plastic DIP |
| MAX208EWG         | -40°C to +85°C | 24 Wide SO            |
| MAX208EAG         | -40°C to +85°C | 24 SSOP               |
| <b>MAX209</b> CNG | 0°C to +70°C   | 24 Narrow Plastic DIP |
| MAX209CWG         | 0°C to +70°C   | 24 Wide SO            |
| MAX209C/D         | 0°C to +70°C   | Dice*                 |
| MAX209ENG         | -40°C to +85°C | 24 Narrow Plastic DIP |
| MAX209EWG         | -40°C to +85°C | 24 Wide SO            |
| <b>MAX211</b> CWI | 0°C to +70°C   | 28 Wide SO            |
| MAX211CAI         | 0°C to +70°C   | 28 SSOP               |
| MAX211C/D         | 0°C to +70°C   | Dice*                 |
| MAX211EWI         | -40°C to +85°C | 28 Wide SO            |
| MAX211EAI         | -40°C to +85°C | 28 SSOP               |
| <b>MAX213</b> CWI | 0°C to +70°C   | 28 Wide SO            |
| MAX213CAI         | 0°C to +70°C   | 28 SSOP               |
| MAX213C/D         | 0°C to +70°C   | Dice*                 |
| MAX213EWI         | -40°C to +85°C | 28 Wide SO            |
| MAX213EAI         | -40°C to +85°C | 28 SSOP               |

\*Contact factory for dice specifications.

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## Selector Guide (continued)

| PART   | POWER-SUPPLY VOLTAGE (V) | NUMBER OF RS-232 DRIVERS | NUMBER OF RS-232 RECEIVERS | NUMBER OF RECEIVERS ACTIVE IN SHUTDOWN | NUMBER OF EXTERNAL CAPACITORS (0.1µF) | LOW-POWER SHUTDOWN/TTL THREE-STATE |
|--------|--------------------------|--------------------------|----------------------------|----------------------------------------|---------------------------------------|------------------------------------|
| MAX204 | +5                       | 4                        | 0                          | 0                                      | 4                                     | No/No                              |
| MAX205 | +5                       | 5                        | 5                          | 0                                      | None                                  | Yes/Yes                            |
| MAX206 | +5                       | 4                        | 3                          | 0                                      | 4                                     | Yes/Yes                            |
| MAX207 | +5                       | 5                        | 3                          | 0                                      | 4                                     | No/No                              |
| MAX208 | +5                       | 4                        | 4                          | 0                                      | 4                                     | No/No                              |
| MAX209 | +5 and +9.0 to +13.2     | 3                        | 5                          | 0                                      | 2                                     | No/Yes                             |
| MAX211 | +5                       | 4                        | 5                          | 0                                      | 4                                     | Yes/Yes                            |
| MAX213 | +5                       | 4                        | 5                          | 2                                      | 4                                     | Yes/Yes                            |

## Package Information

For the latest package outline information and land patterns (footprints), go to [www.maximintegrated.com/packages](http://www.maximintegrated.com/packages). Note that a “+”, “#”, or “-” in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

| PACKAGE TYPE | PACKAGE CODE | DOCUMENT NO.            |
|--------------|--------------|-------------------------|
| 14 CDIP      | J14-3        | <a href="#">21-0045</a> |
| 16 CDIP      | J16-3        | <a href="#">21-0045</a> |
| 20 CDIP      | J20-2        | <a href="#">21-0045</a> |
| 24 CDIP      | R24-4        | <a href="#">21-0045</a> |
| 14 PDIP      | P14-3        | <a href="#">21-0043</a> |
| 16 PDIP      | P16-1        | <a href="#">21-0043</a> |
| 20 PDIP      | P20-3        | <a href="#">21-0043</a> |
| 24 PDIP      | N24-2        | <a href="#">21-0043</a> |
| 24 PDIP      | N24-3        | <a href="#">21-0043</a> |
| 24 PDIP      | P24-1        | <a href="#">21-0044</a> |
| 24 PDIP      | P24M-1       | <a href="#">21-0044</a> |
| 16 SO        | S16-3        | <a href="#">21-0041</a> |
| 16 SO        | W16-3        | <a href="#">21-0042</a> |
| 16 SO        | W16-1        | <a href="#">21-0042</a> |
| 20 SO        | W20M-1       | <a href="#">21-0042</a> |
| 20 SO        | W20-3        | <a href="#">21-0042</a> |
| 24 SO        | W24-2        | <a href="#">21-0042</a> |
| 28 SO        | W28-1        | <a href="#">21-0042</a> |
| 28 SO        | W28-2        | <a href="#">21-0042</a> |
| 24 SSOP      | A24-3        | <a href="#">21-0056</a> |
| 24 SSOP      | A24-2        | <a href="#">21-0056</a> |
| 28 SSOP      | A28-1        | <a href="#">21-0056</a> |
| 16 TSSOP     | U16-1        | <a href="#">21-0066</a> |

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## Revision History

| REVISION<br>NUMBER | REVISION<br>DATE | DESCRIPTION                                                                                                 | PAGES<br>CHANGED |
|--------------------|------------------|-------------------------------------------------------------------------------------------------------------|------------------|
| 6                  | 10/03            | Changed the Features section and section information to the <i>Next-Generation Device Features</i> section. | 1                |
| 7                  | 12/05            | Added Note 1 to the <i>Absolute Maximum Ratings</i> section.                                                | 2                |
| 8                  | 1/15             | Updated page 1 content                                                                                      | 1                |

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

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