

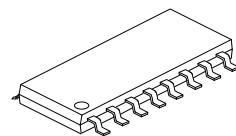
## DESCRIPTION

The MAX3232CSE+T has two receivers and two drivers, and a dual charge-pump circuit.

The device meets the requirements of TIA/EIA-232-F and provides the electrical interface between an asynchronous communication controller and the serial-port connector.

The charge pump and four small external capacitors allow operation from a single 3.0V to 5.5V supply.

The device operates at data signaling rates up to 250kbit/s and a maximum of 35V/ $\mu$ s driver output slew rate.

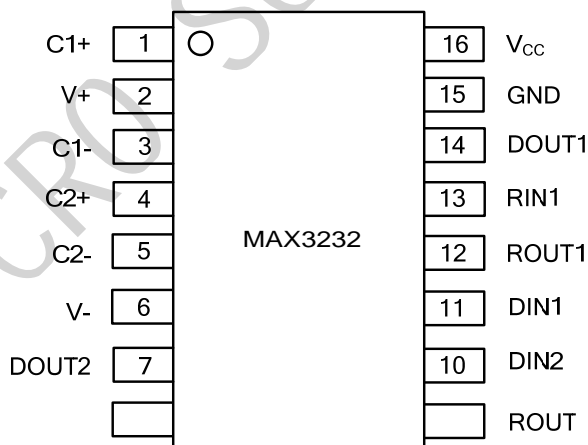


SOP-16

## FEATURES

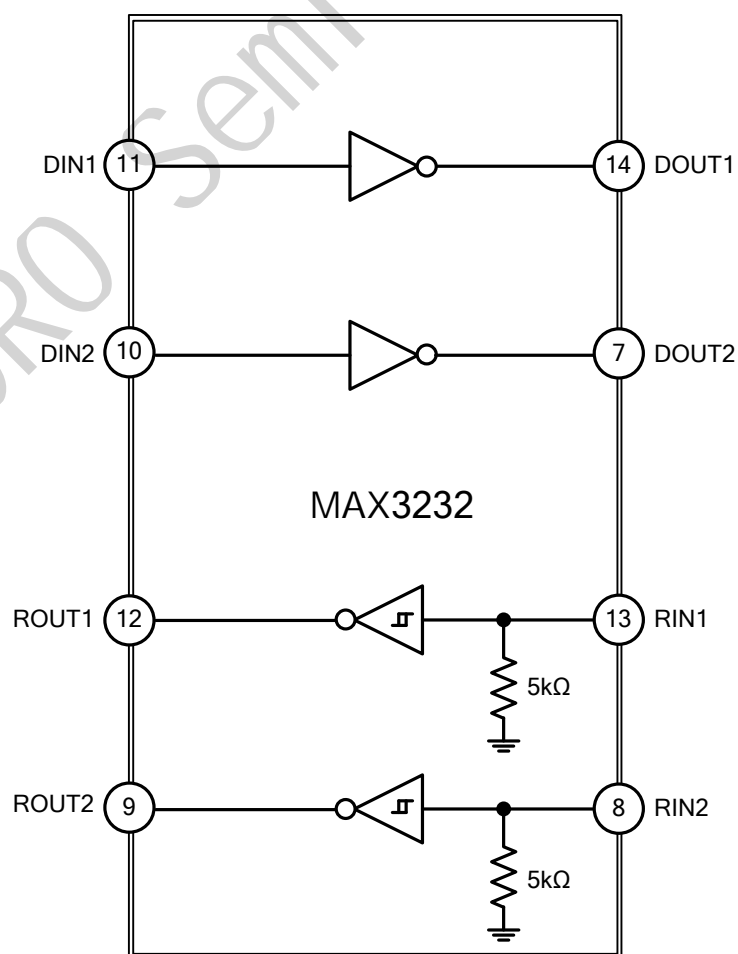
- \* Exceeds  $\pm 8$ KV ESD Protection(HBM) for RS-232 I/O Pins
- \* Meets the Requirements of TIA/EIA-232-F and ITU V.28 Standards
- \* Operates With 3.0V to 5.5V  $V_{CC}$  Supply
- \* Operates Up To 250kbit/s Data Rate
- \* Two Drivers and Two Receivers
- \* External Capacitors  $4 \times 0.1\mu F$
- \* Accepts 5.0V Logic Input With 3.3V Supply

## PIN CONFIGURATION



**PIN DESCRIPTION**

| PIN NO. | PIN NAME        | DESCRIPTION  |
|---------|-----------------|--|
| 1       | C1+             | Positive Terminal of Voltage-Doubler Charge-Pump Capacitor |
| 2       | V+              | +5.5V Generated by the Charge Pump                         |
| 3       | C1-             | Negative Terminal of Voltage-Doubler Charge-Pump Capacitor |
| 4       | C2+             | Positive Terminal of Inverting Charge-Pump Capacitor       |
| 5       | C2-             | Negative Terminal of Inverting Charge-Pump Capacitor       |
| 6       | V-              | -5.5V Generated by the Charge Pump                         |
| 7       | DOUT2           | RS-232 Driver Outputs                                      |
| 8       | RIN2            | RS-232 Receiver Inputs                                     |
| 9       | ROUT2           | TTL/CMOS Receiver Outputs                                  |
| 10      | DIN2            | TTL/CMOS Driver Inputs                                     |
| 11      | DIN1            | TTL/CMOS Driver Inputs                                     |
| 12      | ROUT1           | TTL/CMOS Receiver Outputs                                  |
| 13      | RIN1            | RS-232 Receiver Inputs                                     |
| 14      | DOUT1           | RS-232 Driver Outputs                                      |
| 15      | GND             | Ground   |
| 16      | V <sub>CC</sub> | +3.0V to +5.5V Supply Voltage                              |

**BLOCK DIAGRAM**


**ABSOLUTE MAXIMUM RATING [Over operating free-air temperature range (unless otherwise noted)]**

| PARAMETER                                     |           | SYMBOL    | RATINGS             | UNIT |
|---|-----------|-----------|---------------------|------|
| Supply Voltage Range                          |           | $V_{CC}$  | -0.3 ~ +6.0         | V    |
| Positive Output Supply Voltage Range (Note 2) |           | $V+$      | -0.3 ~ +7.0         | V    |
| Negative Output Supply Voltage Range (Note 2) |           | $V-$      | +0.3 ~ -7.0         | V    |
| Supply Voltage Difference (Note 2)            |           | $V+ - V-$ | +13                 | V    |
| Input Voltage                                 | Drivers   | $V_{IN}$  | -0.3 ~ +6.0         | V    |
|   | Receivers |           | -25 ~ +25           | V    |
| Output Voltage                                | Drivers   | $V_{OUT}$ | -13.2 ~ +13.2       | V    |
|   | Receivers |           | -0.3 ~ $V_{CC}+0.3$ | V    |
| Operating Virtual Junction Temperature        |           | $T_J$     | +150                | °C   |
| Storage Temperature                           |           | $T_{STG}$ | -65 ~ + 150         | °C   |

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. All voltages are with respect to network GND.

**THERMAL DATA**

| PARAMETER           |        | SYMBOL        | RATING | UNIT |
|---------------------|--------|---------------|--------|------|
| Junction to Ambient | SOP-16 | $\theta_{JA}$ | 105    | °C/W |

**RECOMMENDED OPERATING CONDITIONS (See Note & Table 1)**

| PARAMETER                                   | SYMBOL    | TEST CONDITIONS | MIN           | TYP | MAX | UNIT |
|---|-----------|-----------------|---------------|-----|-----|------|
| Supply Voltage                              | $V_{CC}$  | $V_{CC}=3.3V$   | 3.0           | 3.3 | 3.6 | V    |
|   |           | $V_{CC}=5.0V$   | 4.5           | 5.0 | 5.5 | V    |
| Driver and Control High-level Input Voltage | $V_{IH}$  | DIN             | $V_{CC}=3.3V$ | 2.0 |     | V    |
|   |           |                 | $V_{CC}=5.5V$ | 2.4 |     |      |
| Driver and Control Low-level Input Voltage  | $V_{IL}$  | DIN             |               |     | 0.8 | V    |
| Driver and Control Input Voltage            | $V_{IN}$  | DIN             |               |     | 5.5 | V    |
| Receiver Input Voltage                      | $V_{RIN}$ |                 | -25           |     | 25  | V    |
| Operating Free-Air Temperature              | $T_A$     |                 | 0             |     | 70  | °C   |

Notes: Test conditions are  $C1\sim C4=0.1\mu F$  at  $V_{CC}=3.3V\pm 0.3V$ ;  $C1=0.047\mu F$ ,  $C2\sim C4=0.33\mu F$  at  $V_{CC}=5.0V\pm 0.5V$ .

**ELECTRICAL CHARACTERISTICS** [(over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 3 & Table 1)]

| PARAMETER                                 | SYMBOL    | TEST CONDITIONS  | MIN           | TYP<br>(Note 1) | MAX      | UNIT       |
|---|-----------|--|---------------|-----------------|----------|------------|
| Supply Current                            | $I_{CC}$  | No load  |               | 0.3             | 1.0      | mA         |
| <b>DRIVER SECTION</b>                     |           |  |               |                 |          |            |
| High-Level Output Voltage                 | $V_{OH}$  | DO <sub>UT</sub> at $R_L=3k\Omega$ to GND, DIN=GND       | +5.0          | +5.4            |          | V          |
| Low-Level Output Voltage                  | $V_{OL}$  | DO <sub>UT</sub> at $R_L=3k\Omega$ to GND, DIN= $V_{CC}$ | -5.0          | -5.4            |          | V          |
| High-Level Input Current                  | $I_{OH}$  | $V_I=V_{CC}$   |               | $\pm 0.01$      | $\pm 1$  | $\mu A$    |
| Low-Level Input Current                   | $I_{OL}$  | $V_I$ at GND   |               | $\pm 0.01$      | $\pm 1$  | $\mu A$    |
| Short-Circuit Output Current<br>(Note 2)  | $I_{OS}$  | $V_{CC}=3.6V, V_{OUT}=0V$                                |               | $\pm 35$        | $\pm 60$ | mA         |
|   |           | $V_{CC}=5.5V, V_{OUT}=0V$                                |               | $\pm 35$        | $\pm 60$ | mA         |
| Output Resistance                         | $r_O$     | $V_{CC}, V+$ and $V- =0V, V_{OUT}=\pm 2.0V$              | 300           | 10M             |          | $\Omega$   |
| <b>RECEIVER SECTION</b>                   |           |  |               |                 |          |            |
| High-Level Output Voltage                 | $V_{OH}$  | $I_{OH}=-1.0mA$  | $V_{CC}-0.6V$ | $V_{CC}-0.1V$   |          | V          |
| Low-Level Output Voltage                  | $V_{OL}$  | $I_{OL}=1.6mA$   |               |                 | 0.4      | V          |
| Positive-Going Input Threshold<br>Voltage | $V_{IT+}$ | $V_{CC}=3.3V$  |               | 1.5             | 2.4      | V          |
|   |           | $V_{CC}=5.0V$  |               | 1.8             | 2.4      | V          |
| Negative-Going Input<br>Threshold Voltage | $V_{IT-}$ | $V_{CC}=3.3V$  | 0.6           | 1.2             |          | V          |
|   |           | $V_{CC}=5.0V$  | 0.8           | 1.5             |          | V          |
| Input Hysteresis                          | $V_{HYS}$ | $V_{IT+}\sim V_{IT-}$                                    |               | 0.3             |          | V          |
| Input Resistance                          | $R_i$     | $V_I=\pm 3.0V\sim\pm 25V$                                | 3             | 5               | 7        | k $\Omega$ |

Notes: 1. All typical values are at  $V_{CC}=3.3V$  or  $V_{CC}=5.0V$ , and  $T_A=25^\circ C$ .

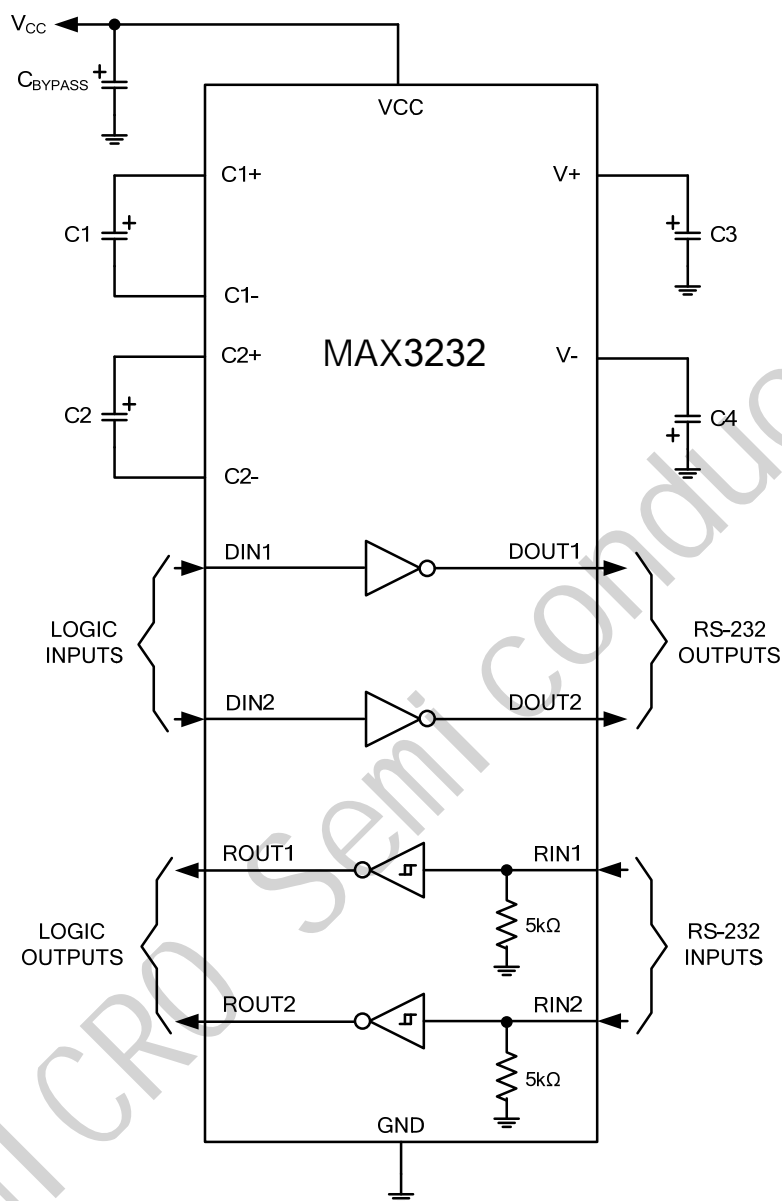
- Short-circuit durations should be controlled to prevent exceeding the device absolute power-dissipation ratings, and not more than one output should be shorted at a time.
- Test conditions are  $C1\sim C4=0.1\mu F$  at  $V_{CC}=3.3V\pm 0.3V$ ;  $C1=0.047\mu F, C2\sim C4=0.33\mu F$  at  $V_{CC}=5.0V\pm 0.5V$ .
- Pulse skew is defined as  $|t_{PLH}-t_{PHL}|$  of each channel of the same device.

**SWITCHING CHARACTERISTICS** [(over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 3 and Table 1)]

| PARAMETER  | SYMBOL      | TEST CONDITIONS                                   | MIN | TYP<br>(Note 1) | MAX | UNIT       |
|--|-------------|---|-----|-----------------|-----|------------|
| <b>DRIVER SECTION</b>                            |             |   |     |                 |     |            |
| Maximum Data Rate                                |             | $C_L=1000pF, R_L=3k\Omega$ , One Driver Switching | 120 |                 | 250 | Kbit/s     |
| Pulse Skew (Note 4)                              | $t_{SK(P)}$ | $C_L=220pF\sim 2500pF, R_L=3k\Omega\sim 7k\Omega$ |     | 300             |     | ns         |
| Slew Rate, Transition Region                     | SR(tr)      | $R_L=3k\Omega\sim 7k\Omega, C_L=220pF\sim 1000pF$ | 5   |                 | 35  | V/ $\mu s$ |
|  |             | $V_{CC}=3.3V, C_L=220pF\sim 2500pF$               | 3   |                 | 35  |            |
| <b>RECEIVER SECTION</b>                          |             |   |     |                 |     |            |
| Propagation Delay Time, Low-to High-Level Output | $t_{PLH}$   | $C_L=150pF$                                       |     | 300             |     | ns         |
| Propagation Delay Time, High-to Low-Level Output | $t_{PHL}$   | $C_L=150pF$                                       |     | 300             |     | ns         |
| Output Enable Time                               | $t_{EN}$    | $C_L=150pF, R_L=3k\Omega$                         |     | 200             |     | ns         |
| Output Disable Time                              | $t_{DIS}$   | $C_L=150pF, R_L=3k\Omega$                         |     | 200             |     | ns         |
| Pulse Skew (Note 4)                              | $t_{SK(P)}$ | $ t_{PLH}-t_{PHL} $                               |     | 300             |     | ns         |

Notes: 1. All typical values are at  $V_{CC}=3.3V$  or  $V_{CC}=5.0V$ , and  $T_A=25^\circ C$ .

- Short-circuit durations should be controlled to prevent exceeding the device absolute power-dissipation ratings, and not more than one output should be shorted at a time.
- Test conditions are  $C1\sim C4=0.1\mu F$  at  $V_{CC}=3.3V\pm 0.3V$ ;  $C1=0.047\mu F, C2\sim C4=0.33\mu F$  at  $V_{CC}=5.0V\pm 0.5V$ .
- Pulse skew is defined as  $|t_{PLH}-t_{PHL}|$  of each channel of the same device.

**TYPICAL APPLICATION CIRCUIT**


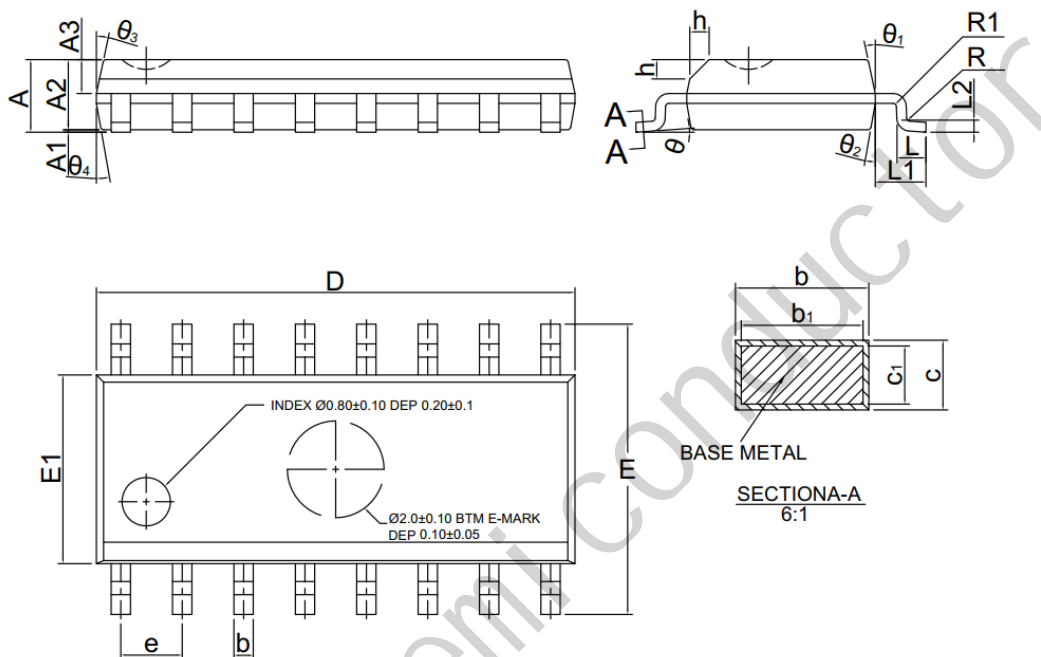
- Notes: 1. C3 can be connected to V<sub>CC</sub> or GND.  
 2. Resistor values shown are nominal.  
 3. NC: No internal connection.  
 4. Nonpolarized ceramic capacitors are acceptable. If polarized tantalum or electrolytic capacitors are used, they should be connected as shown.

Table1. Typical Operating Circuit and Capacitor Values

| V <sub>CC</sub> (V) | C1 (μF) | C2, C3, C4 (μF) | C <sub>BYPASS</sub> (μF) |
|---------------------|---------|-----------------|--------------------------|
| 3.0~3.6             | 0.22    | 0.22            | 0.22                     |
| 3.15~3.6            | 0.1     | 0.1             | 0.1                      |
| 4.5~5.5             | 0.047   | 0.33            | 0.047                    |
| 3.0~5.5             | 0.22    | 1.0             | 0.22                     |

## Package Information

### SOP-16



SOP-16 Package Dimensions

| Size Symbol | MIN(mm) | TYP(mm) | MAX(mm) | Size Symbol | MIN(mm) | TYP(mm) | MAX(mm) |
|-------------|---------|---------|---------|-------------|---------|---------|---------|
| A           | 1.25    | 1.50    | 1.75    | L           | 0.45    | 0.60    | 0.80    |
| A1          | 0.00    | -       | 0.10    | L1          | 1.04REF |         |         |
| A2          | 1.25    | 1.45    | 1.65    | L2          | 0.25BSC |         |         |
| A3          | 0.55    | 0.65    | 0.75    | R           | 0.07    | -       | -       |
| b           | 0.36    | -       | 0.51    | R1          | 0.07    | -       | -       |
| b1          | 0.35    | 0.40    | 0.45    | h           | 0.30    | 0.40    | 0.50    |
| c           | 0.17    | -       | 0.25    |             |         |         |         |
| c1          | 0.17    | 0.20    | 0.23    | θ           | 0       | -       | 8°      |
| D           | 9.80    | 9.90    | 10.00   | θ1          | 10°     | 12°     | 14°     |
| E           | 5.80    | 6.00    | 6.20    | θ2          | 8°      | 10°     | 12°     |
| E1          | 3.80    | 3.90    | 4.10    | θ3          | 10°     | 12°     | 14°     |
| e           | 1.27BSC |         |         | θ4          | 8°      | 10°     | 12°     |