The MAX3232 device consists of two line drivers, two line receivers, and a dual charge-pump circuit with ±15-kV ESD protection pin to pin (serial-port connection pins, including GND). 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-V to 5.5-V supply. The devices operate at data signaling rates up to 250 kbit/s and a maximum of 30-V/µs driver output slew rate.

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>TA</th>
<th>PACKAGE†</th>
<th>ORDERABLE PART NUMBER</th>
<th>TOP-SIDE MARKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C to 70°C</td>
<td>SOIC – D</td>
<td>Tube</td>
<td>MAX3232CD</td>
</tr>
<tr>
<td></td>
<td>SOIC – DW</td>
<td>Tube</td>
<td>MAX3232CDW</td>
</tr>
<tr>
<td></td>
<td>SSOP – DB</td>
<td>Tube</td>
<td>MAX3232CDBR</td>
</tr>
<tr>
<td></td>
<td>TSSOP – PW</td>
<td>Tube</td>
<td>MAX3232CPSWR</td>
</tr>
<tr>
<td>-40°C to 85°C</td>
<td>SOIC – D</td>
<td>Tube</td>
<td>MAX3232ID</td>
</tr>
<tr>
<td></td>
<td>SOIC – DW</td>
<td>Tube</td>
<td>MAX3232IDW</td>
</tr>
<tr>
<td></td>
<td>SSOP – DB</td>
<td>Tube</td>
<td>MAX3232IDBR</td>
</tr>
<tr>
<td></td>
<td>TSSOP – PW</td>
<td>Tube</td>
<td>MAX3232IPWR</td>
</tr>
</tbody>
</table>

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

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**Function Tables**

**EACH DRIVER**

<table>
<thead>
<tr>
<th>INPUT DIN</th>
<th>OUTPUT DOUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
</tr>
</tbody>
</table>

H = high level, L = low level

**EACH RECEIVER**

<table>
<thead>
<tr>
<th>INPUT RIN</th>
<th>OUTPUT ROUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>Open</td>
<td>H</td>
</tr>
</tbody>
</table>

H = high level, L = low level, Open = input disconnected or connected driver off

**logic diagram (positive logic)**

```
\[
\begin{align*}
\text{DIN1} & \quad 11 \quad \rightarrow \quad 14 \quad \text{DOUT1} \\
\text{DIN2} & \quad 10 \quad \rightarrow \quad 7 \quad \text{DOUT2} \\
\text{ROUT1} & \quad 12 \quad \rightarrow \quad 13 \quad \text{RIN1} \\
\text{ROUT2} & \quad 9 \quad \rightarrow \quad 8 \quad \text{RIN2}
\end{align*}
\]```
absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

- Supply voltage range, $V_{CC}$ (see Note 1) .............................................................................. $-0.3$ V to 6 V
- Positive output supply voltage range, $V+$ (see Note 1) .......................................................... $-0.3$ V to 7 V
- Negative output supply voltage range, $V-$ (see Note 1) .......................................................... $0.3$ V to $-7$ V
- Supply voltage difference, $V+$ $-$ $V-$ (see Note 1) ................................................................. $13$ V
- Input voltage range, $V_I$: Drivers ................................................................................... $-0.3$ V to 6 V
  Receivers .................................................................................................................. $-25$ V to 25 V
- Output voltage range, $V_O$: Drivers ............................................................................... $-13.2$ V to 13.2 V
  Receivers .................................................................................................................. $-0.3$ V to $V_{CC} + 0.3$ V
- Package thermal impedance, $\theta_{JA}$ (see Note 2): D package ........................................... 73°C/W
  DB package .............................................................................................................. 82°C/W
  DW package .............................................................................................................. 57°C/W
  PW package .............................................................................................................. 108°C/W
- Lead temperature 1.6 mm (1/16 inch) from case for 10 seconds ........................................... 260°C
- Storage temperature range, $T_{stg}$ ....................................................................................... $-65$°C to 150°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 under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltages are with respect to network GND.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 3 and Figure 4)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>NOM</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>$V_{CC} = 3.3$ V</td>
<td>3</td>
<td>3.3</td>
<td>3.6</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>$V_{CC} = 5$ V</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>$V_{IH}$ Driver high-level input voltage</td>
<td>DIN</td>
<td>$V_{CC} = 3.3$ V</td>
<td>2</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{CC} = 5$ V</td>
<td>2.4</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{IL}$ Driver low-level input voltage</td>
<td>DIN</td>
<td>0</td>
<td>0.8</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_I$ Driver input voltage</td>
<td>DIN</td>
<td>0</td>
<td>5.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Receiver input voltage</td>
<td>$T_A$ Operating free-air temperature</td>
<td>$-25$</td>
<td>25</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MAX3232C</td>
<td>0</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MAX3232I</td>
<td>-40</td>
<td>85</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE 3: Test conditions are $C_1$–$C_4 = 0.1$ μF at $V_{CC} = 3.3$ V $\pm 0.3$ V; $C_1 = 0.047$ μF; $C_2$–$C_4 = 0.33$ μF at $V_{CC} = 5$ V $\pm 0.5$ V.

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 3 and Figure 4)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP‡</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{CC}$ Supply current</td>
<td>No load, $V_{CC} = 3.3$ V or 5 V</td>
<td>0.3</td>
<td>1</td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>

‡ All typical values are at $V_{CC} = 3.3$ V or $V_{CC} = 5$ V, and $T_A = 25$°C.

NOTE 3: Test conditions are $C_1$–$C_4 = 0.1$ μF at $V_{CC} = 3.3$ V $\pm 0.3$ V; $C_1 = 0.047$ μF; $C_2$–$C_4 = 0.33$ μF at $V_{CC} = 5$ V $\pm 0.5$ V.
### Driver Section

**Electrical Characteristics**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ†</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOH</td>
<td>DOUT at RL = 3 kΩ to GND, DIN = GND</td>
<td>5</td>
<td>5.4</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>VOL</td>
<td>DOUT at RL = 3 kΩ to GND, DIN = VCC</td>
<td>-5</td>
<td>-5.4</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>IH</td>
<td>VI = VCC</td>
<td>±0.01</td>
<td>±1</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>IIL</td>
<td>VI at GND</td>
<td>±0.01</td>
<td>±1</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>IOS‡</td>
<td>VCC = 3.6 V, VO = 0 V</td>
<td>±35</td>
<td>±60</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>IOS‡</td>
<td>VCC = 5.5 V, VO = 0 V</td>
<td>±35</td>
<td>±60</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>rO</td>
<td>VCC, V+, and V− = 0 V, VO = ±2 V</td>
<td>300</td>
<td>10M</td>
<td></td>
<td>Ω</td>
</tr>
</tbody>
</table>

†All typical values are at VCC = 3.3 V or VCC = 5 V, and TA = 25°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.

**NOTE 3:** Test conditions are C1–C4 = 0.1 µF at VCC = 3.3 V ± 0.3 V; C1 = 0.047 µF, C2–C4 = 0.33 µF at VCC = 5 V ± 0.5 V.

**Switching Characteristics**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ†</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum data rate</td>
<td>CL = 1000 pF, One DOUT switching,</td>
<td>150</td>
<td>250</td>
<td></td>
<td>kbit/s</td>
</tr>
<tr>
<td></td>
<td>RL = 3 kΩ, See Figure 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tsk(p)</td>
<td>CL = 150 pF to 2500 pF</td>
<td>300</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>SR(tr)</td>
<td>RL = 3 kΩ to 7 kΩ, See Figure 2</td>
<td>6</td>
<td>30</td>
<td></td>
<td>V/µs</td>
</tr>
<tr>
<td></td>
<td>CL = 150 pF to 1000 pF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CL = 150 pF to 2500 pF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

†All typical values are at VCC = 3.3 V or VCC = 5 V, and TA = 25°C.
§Pulse skew is defined as |tPLH − tPHL| of each channel of the same device.

**NOTE 3:** Test conditions are C1–C4 = 0.1 µF at VCC = 3.3 V ± 0.3 V; C1 = 0.047 µF, C2–C4 = 0.33 µF at VCC = 5 V ± 0.5 V.
RECEIVER SECTION

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 3 and Figure 4)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP†</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{OH}$ High-level output voltage</td>
<td>$I_{OH} = -1$ mA</td>
<td>$V_{CC} - 0.6$ V</td>
<td>$V_{CC} - 0.1$ V</td>
<td>0.4 V</td>
<td></td>
</tr>
<tr>
<td>$V_{OL}$ Low-level output voltage</td>
<td>$I_{OL} = -1.6$ mA</td>
<td>$V_{CC} - 0.6$ V</td>
<td>$V_{CC} - 0.1$ V</td>
<td>0.4 V</td>
<td></td>
</tr>
<tr>
<td>$V_{\text{IT}+}$ Positive-going input threshold voltage</td>
<td>$V_{CC} = 3.3$ V</td>
<td>1.5 V</td>
<td>2.4 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{\text{IT}+}$ Negative-going input threshold voltage</td>
<td>$V_{CC} = 3.3$ V</td>
<td>0.6 V</td>
<td>1.2 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{\text{IT}+}$ Inductance (in $V_{\text{IT}+} - V_{\text{IT}+}$)</td>
<td></td>
<td>0.3 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_i$ Input resistance</td>
<td>$V_I = \pm 3$ V to $\pm 25$ V</td>
<td>3 kΩ</td>
<td>5 kΩ</td>
<td>7 kΩ</td>
<td></td>
</tr>
</tbody>
</table>

† All typical values are at $V_{CC} = 3.3$ V or $V_{CC} = 5$ V, and $T_A = 25^\circ$C.

NOTE 3: Test conditions are $C_1 - C_4 = 0.1$ μF at $V_{CC} = 3.3$ V $\pm 0.3$ V; $C_1 = 0.047$ μF, $C_2 - C_4 = 0.33$ μF at $V_{CC} = 5$ V $\pm 0.5$ V.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 3 and Figure 3)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP†</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_{PLH}$ Propagation delay time, low- to high-level output</td>
<td>$C_L = 150$ pF</td>
<td>300 ns</td>
<td>300 ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$t_{PHL}$ Propagation delay time, high- to low-level output</td>
<td></td>
<td>300 ns</td>
<td>300 ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$t_{\text{sk}(p)}$ Pulse skew†</td>
<td></td>
<td>300 ns</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† All typical values are at $V_{CC} = 3.3$ V or $V_{CC} = 5$ V, and $T_A = 25^\circ$C.
‡ Pulse skew is defined as $|t_{PLH} - t_{PHL}|$ of each channel of the same device.

NOTE 3: Test conditions are $C_1 - C_4 = 0.1$ μF at $V_{CC} = 3.3$ V $\pm 0.3$ V; $C_1 = 0.047$ μF, $C_2 - C_4 = 0.33$ μF at $V_{CC} = 5$ V $\pm 0.5$ V.

PARAMETER MEASUREMENT INFORMATION

![Test Circuit](image1)

NOTES: A. $C_L$ includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR = 250 kbit/s, $Z_O = 50$ Ω, 50% duty cycle, $t_f \leq 10$ ns, $t_r \leq 10$ ns.

Figure 1. Driver Slew Rate
PARAMETER MEASUREMENT INFORMATION

NOTES:

A. \( C_L \) includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 250 kbit/s, \( Z_O = 50 \Omega \), 50% duty cycle, \( t_r \leq 10 \text{ ns}, t_f \leq 10 \text{ ns} \).

Figure 2. Driver Pulse Skew

NOTES:

A. \( C_L \) includes probe and jig capacitance.

B. The pulse generator has the following characteristics: \( Z_O = 50 \Omega \), 50% duty cycle, \( t_r \leq 10 \text{ ns}, t_f \leq 10 \text{ ns} \).

Figure 3. Receiver Propagation Delay Times
**APPLICATION INFORMATION**

![Circuit Diagram](image)

† C3 can be connected to VCC or GND.

<table>
<thead>
<tr>
<th>VCC vs CAPACITOR VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VCC</strong></td>
</tr>
<tr>
<td>3.3 V ± 0.3 V</td>
</tr>
<tr>
<td>5 V ± 0.5 V</td>
</tr>
<tr>
<td>3 V to 5.5 V</td>
</tr>
</tbody>
</table>

Figure 4. Typical Operating Circuit and Capacitor Values
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