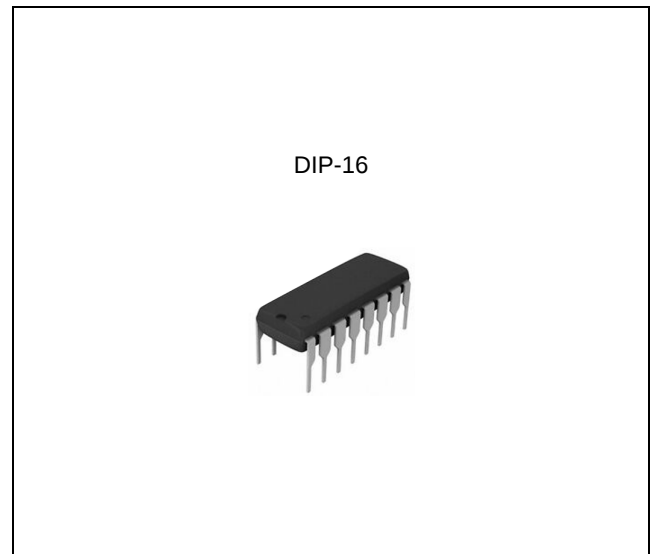


**FEATURES**

- Output voltage levels are compatible with input levels of CMOS and TTL integrated circuits
- Meets All EIA/TIA-232E and V.28/V.24 Specifications
- Supply voltage range from 4.5 to 5.5V
- Low input current: 1.0 $\mu$ A at 25°C
- Output current 24mA
- Tolerable value of static potential not less than 2kV
- Available in DIP-16 Package

**APPLICATIONS**

- Portable Computers
- Battery-Powered RS-232 Systems
- Interface Translation
- Low-Power Modems
- Terminals

**ORDERING INFORMATION**

| Device   | Package |
|----------|---------|
| MAX232EN | DIP-16  |

\* Refer to the ordering information for the details.

**DESCRIPTION**

The MAX232 is a dual driver/receiver of RS-232 standard with a single supply voltage and bipolar output voltage of the transmitter formed by a built-in voltage multiplying generator on four 1.0 $\mu$ F external capacitors, designed for use in state-of-the-art high performance computing systems, high-speed electronic devices with high reliability of information exchange between remote objects.

Input voltage levels are compatible with standard CMOS and TTL levels.

**ABSOLUTE MAXIMUM RATINGS**

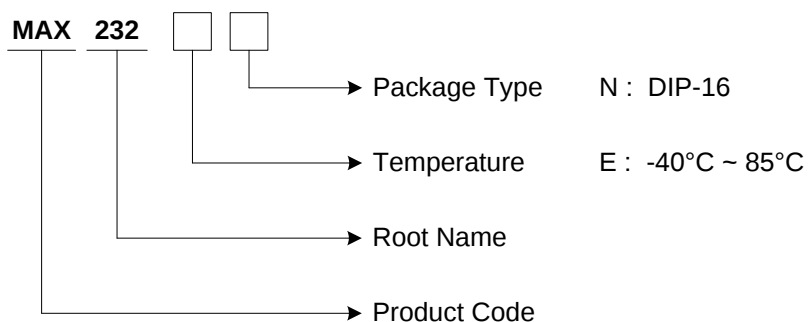
| PARAMETER                             | SYMBOL     | MIN.         | MAX.         | UNIT |
|---------------------------------------|------------|--------------|--------------|------|
| Supply Voltage                        | $V_{CC}$   | -0.3         | 6.0          | V    |
| Transmitter High Output Voltage       | $V_+$      | $V_{CC}-0.3$ | 14           | V    |
| Transmitter Low Output Voltage        | $V_-$      | -14          | 0.3          | V    |
| Transmitter Input Voltage             | $V_{TIN}$  | -0.3         | $V_++0.3$    | V    |
| Receiver Input Voltage                | $V_{RIN}$  | -30          | 30           | V    |
| Voltage Applied to Transmitter Output | $V_{TOUT}$ | $V_- - 0.3$  | $V_++0.3$    | V    |
| Voltage Applied to Receiver Output    | $V_{ROUT}$ | -0.3         | $V_{CC}+0.3$ | V    |
| Storage Temperature Range             | $T_{STG}$  | -65          | 150          | °C   |

## RECOMMENDED OPERATING CONDITIONS

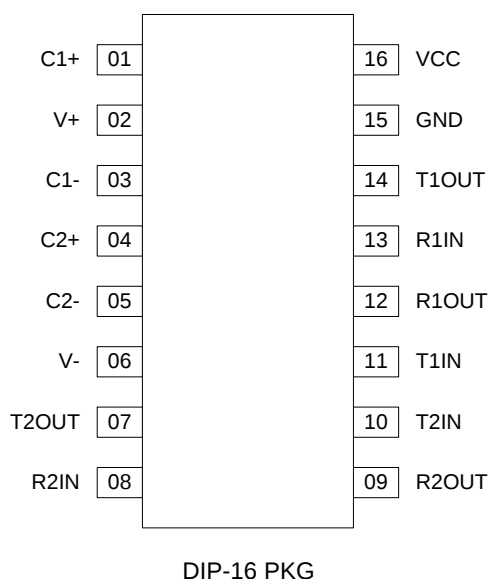
| PARAMETER                                   | SYMBOL    | MIN. | MAX.     | UNIT |
|---------------------------------------------|-----------|------|----------|------|
| Supply Voltage                              | $V_{CC}$  | 4.5  | 5.5      | V    |
| Transmitter Input Voltage                   | $V_{TIN}$ | 0    | $V_{CC}$ | V    |
| Receiver Input Voltage                      | $V_{RIN}$ | -30  | 30       | V    |
| Output Current of Transmitter Short Circuit | $I_{SC}$  | -    | $\pm 60$ | mA   |
| Ambient Temperature Range                   | $T_A$     | -40  | +85      | °C   |

## ORDERING INFORMATION

| Package | Oder No. | Package Marking | Compliance  | Supplied As |
|---------|----------|-----------------|-------------|-------------|
| DIP-16  | MAX232EN | MAX232E         | RoHS, Green | Tube        |



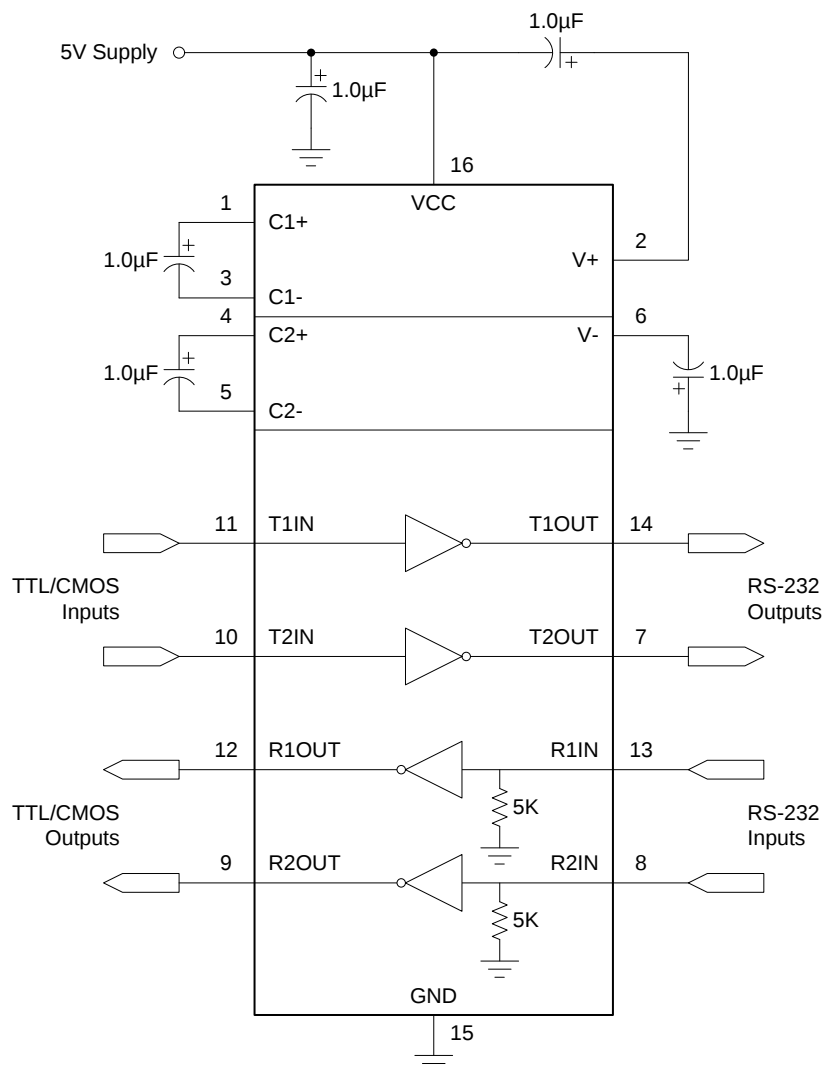
## PIN CONFIGURATION



## PIN DESCRIPTION

| Pin No. | Pin Name | Pin Description                                |
|---------|----------|------------------------------------------------|
| 1       | C1+      | Terminal for Positive Charge-Pump C1 Capacitor |
| 2       | V+       | Positive Voltage Generated by the Charge-Pump  |
| 3       | C1-      | Terminal for Negative Charge-Pump C1 Capacitor |
| 4       | C2+      | Terminal for Positive Charge-Pump C2 Capacitor |
| 5       | C2-      | Terminal for Negative Charge-Pump C2 Capacitor |
| 6       | V-       | Negative Voltage Generated by the Charge-Pump  |
| 7       | T2OUT    | RS-232 Driver Output (Levels RS-232)           |
| 8       | R2IN     | RS-232 Receiver Input (Levels RS-232)          |
| 9       | R2OUT    | RS-232 Receiver Output (Levels TTL/CMOS)       |
| 10      | T2IN     | RS-232 Driver Input (Levels TTL/CMOS)          |
| 11      | T1IN     | RS-232 Driver Input (Levels TTL/CMOS)          |
| 12      | R1OUT    | RS-232 Receiver Output (Levels TTL/CMOS)       |
| 13      | R1IN     | RS-232 Receiver Input (Levels RS-232)          |
| 14      | T1OUT    | RS-232 Driver Output (Levels RS-232)           |
| 15      | GND      | Ground                                         |
| 16      | VCC      | Supply Voltage Input                           |

TYPICAL APPLICATION CIRCUIT



FUNCTION TABLE

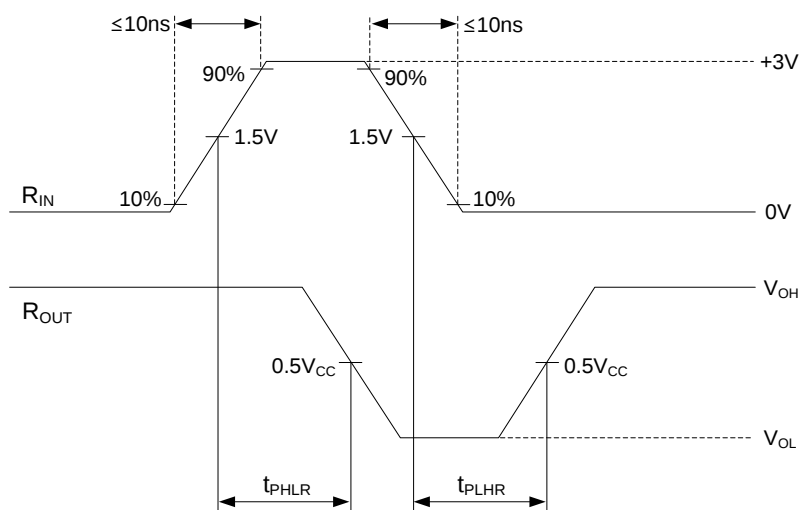
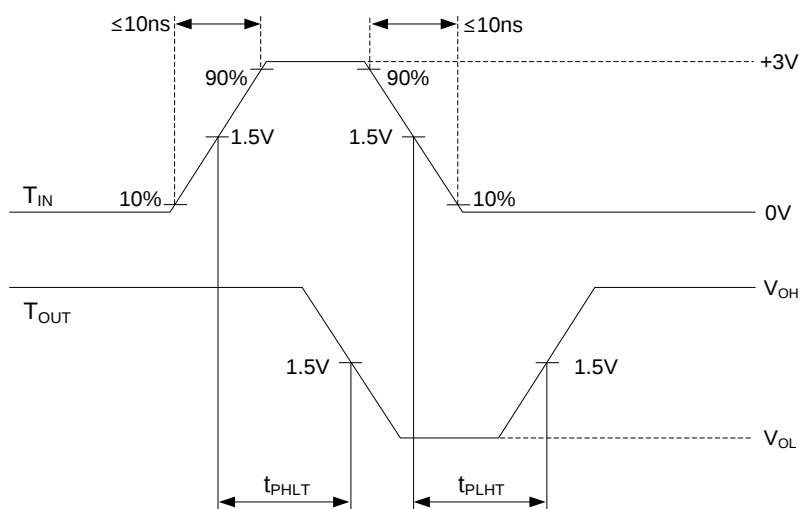
| INPUT<br>(RIN, TIN) | OUTPUT<br>(ROUT, TOUT) |
|---------------------|------------------------|
| L (Low Level)       | H (High Level)         |
| H (High Level)      | L (Low Level)          |

## ELECTRICAL CHARACTERISTICS

(Limits in standard typeface are for  $T_A=25^{\circ}\text{C}$ , and the limits in boldface type apply over full operating temperature range.)

| PARAMETER                                             | SYMBOL                                    | TEST CONDITIONS                                                                                                                                                     |                                  | MIN.       | TYP. | MAX.          | UNIT   |
|-------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------|------|---------------|--------|
| Supply Current                                        | I <sub>CC</sub>                           | V <sub>CC</sub> = 5.5V<br>V <sub>IL</sub> = 0V                                                                                                                      |                                  | -          | -    | 10.0<br>14.0  | mA     |
| Receiver Parameters                                   |                                           |                                                                                                                                                                     |                                  |            |      |               |        |
| Hysteresis Voltage                                    | V <sub>h</sub>                            | V <sub>CC</sub> = 5.0V                                                                                                                                              |                                  | 0.2<br>0.2 | -    | 0.9<br>1.0    | V      |
| On (Operation) Voltage                                | V <sub>on</sub>                           | V <sub>O</sub> ≤ 0.1V, I <sub>OL</sub> ≤ 20μA                                                                                                                       |                                  | -          | -    | 2.4<br>2.3    | V      |
| Off (Dropout) Voltage                                 | V <sub>off</sub>                          | V <sub>O</sub> ≥ V <sub>CC</sub> - 0.1V<br>I <sub>OH</sub> ≤ -20μA                                                                                                  |                                  | 0.8<br>0.9 | -    | -             | V      |
| Output Low Voltage                                    | V <sub>OL</sub>                           | I <sub>L</sub> = 3.2mA, V <sub>CC</sub> = 4.5V,<br>V <sub>IH</sub> = 2.4V                                                                                           |                                  | -          | -    | 0.3<br>0.4    | V      |
| Output High Voltage                                   | V <sub>OH</sub>                           | I <sub>OH</sub> = -1.0mA, V <sub>CC</sub> = 4.5V,<br>V <sub>IL</sub> = 0.8V                                                                                         |                                  | 3.6<br>3.5 | -    | -             | V      |
| Input Resistance                                      | R <sub>I</sub>                            | V <sub>CC</sub> = 5.0V                                                                                                                                              |                                  | 3.0<br>3.0 | -    | 7.0<br>7.0    | kΩ     |
| Transmitter Parameters                                |                                           |                                                                                                                                                                     |                                  |            |      |               |        |
| Output Low Voltage                                    | V <sub>OL</sub>                           | V <sub>CC</sub> = 4.5V, V <sub>IH</sub> = 2.0V,<br>R <sub>L</sub> = 3.0kΩ                                                                                           |                                  | -          | -    | -5.2<br>-5.0  | V      |
| Output High Voltage                                   | V <sub>OH</sub>                           | V <sub>CC</sub> = 4.5V, V <sub>IL</sub> = 0.8V,<br>R <sub>L</sub> = 3.0kΩ                                                                                           |                                  | 5.2<br>5.0 | -    | -             | V      |
| Input Low Current                                     | I <sub>IL</sub>                           | V <sub>CC</sub> = 5.5V, V <sub>IL</sub> = 0V                                                                                                                        |                                  | -          | -    | -1.0<br>-10.0 | μA     |
| Input High Current                                    | I <sub>IH</sub>                           | V <sub>CC</sub> = 5.5V, V <sub>IH</sub> = V <sub>CC</sub>                                                                                                           |                                  | -          | -    | 1.0<br>10.0   | μA     |
| Speed Of Output Front Charge                          | SR                                        | V <sub>CC</sub> = 5.0V, C <sub>L</sub> = 50 - 1000pF,<br>R <sub>L</sub> = 3.0 - 7.0kΩ                                                                               |                                  | 3.0<br>2.7 | -    | 30<br>27      | V/μs   |
| Output Resistance                                     | R <sub>O</sub>                            | V <sub>CC</sub> = V <sub>+</sub> = V <sub>-</sub> = 0V<br>V <sub>O</sub> = ±2V                                                                                      |                                  | 350<br>300 | -    | -             | Ω      |
| Short Circuit Output Current                          | I <sub>SC</sub>                           | V <sub>CC</sub> = 5.5V<br>V <sub>O</sub> = 0V                                                                                                                       | V <sub>I</sub> = V <sub>CC</sub> | -          | -    | -50<br>-60    | mA     |
|                                                       |                                           |                                                                                                                                                                     | V <sub>I</sub> = 0               | -          | -    | 50<br>60      |        |
| Speed Of Information Transmission                     | ST                                        | V <sub>CC</sub> = 4.5V, C <sub>L</sub> = 1000pF,<br>R <sub>L</sub> = 3.0kΩ, t <sub>w</sub> = 7μs (for extreme, t <sub>w</sub> = 8μs)                                |                                  | 140<br>120 | -    | -             | kbit/s |
| Dynamic Parameters                                    |                                           |                                                                                                                                                                     |                                  |            |      |               |        |
| Signal Propagation Delay Time When Switching On (Off) | t <sub>PHLR</sub><br>(t <sub>PLHR</sub> ) | V <sub>CC</sub> = 4.5V, C <sub>L</sub> = 150pF,<br>V <sub>IL</sub> = 0V, V <sub>IH</sub> = 3.0V,<br>t <sub>LH</sub> = t <sub>HL</sub> ≤ 10ns                        |                                  | -          | -    | 9.7<br>10.0   | μs     |
| Signal Propagation Delay Time When Switching On (Off) | t <sub>PHLT</sub><br>(t <sub>PLHT</sub> ) | V <sub>CC</sub> = 4.5V, C <sub>L</sub> = 2500pF,<br>V <sub>IL</sub> = 0V, V <sub>IH</sub> = 3.0V,<br>R <sub>L</sub> = 3kΩ, t <sub>LH</sub> = t <sub>HL</sub> ≤ 10ns |                                  | -          | -    | 5.0<br>6.0    | μs     |

## TIMING DIAGRAM

Figure 1.  $t_{PHL}$  and  $t_{PLH}$  waveforms of ReceiverFigure 2.  $t_{PHL}$  and  $t_{PLH}$  waveforms of Transmitter

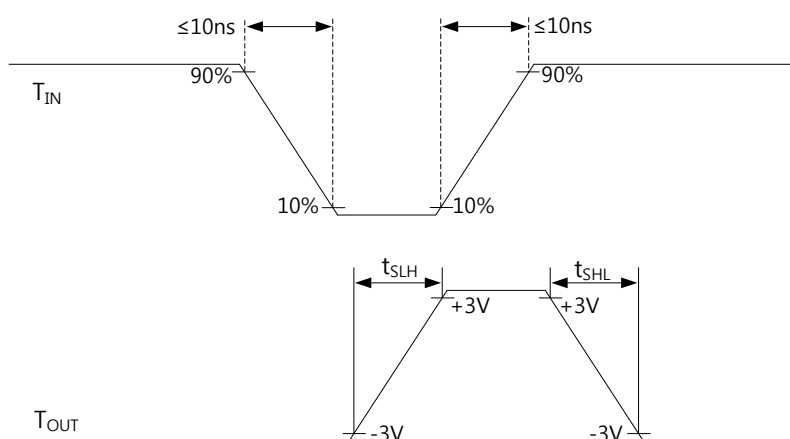


Figure 3.  $t_{SLH}$  and  $t_{SHL}$  waveforms of Transmitter

### REVISION NOTICE

The description in this datasheet is subject to change without any notice to describe its electrical characteristics properly.