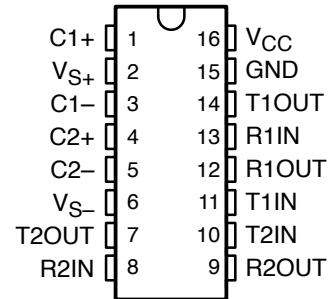


MAX232, MAX232I DUAL EIA-232 DRIVERS/RECEIVERS

SLLS0471 – FEBRUARY 1989 – REVISED OCTOBER 2002

- Meet or Exceed TIA/EIA-232-F and ITU Recommendation V.28
- Operate With Single 5-V Power Supply
- Operate Up to 120 kbit/s
- Two Drivers and Two Receivers
- ± 30 -V Input Levels
- Low Supply Current . . . 8 mA Typical
- Designed to be Interchangeable With Maxim MAX232
- ESD Protection Exceeds JESD 22 – 2000-V Human-Body Model (A114-A)
- Applications
 - TIA/EIA-232-F
 - Battery-Powered Systems
 - Terminals
 - Modems
 - Computers

MAX232 . . . D, DW, N, OR NS PACKAGE
MAX232I . . . D, DW, OR N PACKAGE
(TOP VIEW)



description/ordering information

The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply EIA-232 voltage levels from a single 5-V supply. Each receiver converts EIA-232 inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V and a typical hysteresis of 0.5 V, and can accept ± 30 -V inputs. Each driver converts TTL/CMOS input levels into EIA-232 levels. The driver, receiver, and voltage-generator functions are available as cells in the Texas Instruments LinASIC™ library.

ORDERING INFORMATION

| T _A | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|-----------|---------------|-----------------------|------------------|
| 0°C to 70°C | PDIP (N) | Tube | MAX232N | MAX232N |
| | SOIC (D) | Tube | MAX232D | MAX232 |
| | | Tape and reel | MAX232DR | |
| | SOIC (DW) | Tube | MAX232DW | MAX232 |
| | | Tape and reel | MAX232DWR | |
| –40°C to 85°C | SOP (NS) | Tape and reel | MAX232NSR | MAX232 |
| | PDIP (N) | Tube | MAX232IN | MAX232IN |
| | SOIC (D) | Tube | MAX232ID | MAX232I |
| | | Tape and reel | MAX232IDR | |
| | SOIC (DW) | Tube | MAX232IDW | MAX232I |
| | | Tape and reel | MAX232IDWR | |

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



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MAX232, MAX232I
DUAL EIA-232 DRIVERS/RECEIVERS

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Function Tables

EACH DRIVER

| INPUT TIN | OUTPUT TOUT |
|--------------|----------------|
| L | H |
| H | L |

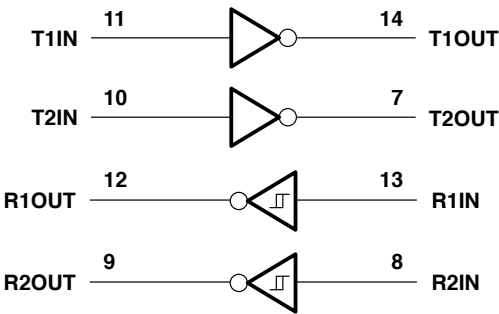
H = high level, L = low level

EACH RECEIVER

| INPUT RIN | OUTPUT ROUT |
|--------------|----------------|
| L | H |
| H | L |

H = high level, L = low level

logic diagram (positive logic)



MAX232, MAX232I DUAL EIA-232 DRIVERS/RECEIVERS

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

| | |
|--|--------------------------------------|
| Input supply voltage range, V_{CC} (see Note 1) | –0.3 V to 6 V |
| Positive output supply voltage range, V_{S+} | $V_{CC} - 0.3$ V to 15 V |
| Negative output supply voltage range, V_{S-} | –0.3 V to –15 V |
| Input voltage range, V_I : Driver | –0.3 V to $V_{CC} + 0.3$ V |
| Receiver | ±30 V |
| Output voltage range, V_O : T1OUT, T2OUT | $V_{S-} - 0.3$ V to $V_{S+} + 0.3$ V |
| R1OUT, R2OUT | –0.3 V to $V_{CC} + 0.3$ V |
| Short-circuit duration: T1OUT, T2OUT | Unlimited |
| Package thermal impedance, θ_{JA} (see Note 2): D package | 73°C/W |
| DW package | 57°C/W |
| N package | 67°C/W |
| NS package | 64°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.

NOTE 1: All voltage values are with respect to network ground terminal.

2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

| | | MIN | NOM | MAX | UNIT |
|------------|---------------------------------------|---------|-----|-----|------|
| V_{CC} | Supply voltage | 4.5 | 5 | 5.5 | V |
| V_{IH} | High-level input voltage (T1IN, T2IN) | 2 | | | V |
| V_{IL} | Low-level input voltage (T1IN, T2IN) | | | 0.8 | V |
| R1IN, R2IN | Receiver input voltage | | | ±30 | V |
| T_A | Operating free-air temperature | MAX232 | 0 | 70 | °C |
| | | MAX232I | –40 | 85 | |

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

| PARAMETER | TEST CONDITIONS | MIN | TYP [‡] | MAX | UNIT |
|-------------------------|---|-----|------------------|-----|------|
| I_{CC} Supply current | $V_{CC} = 5.5$ V, All outputs open, $T_A = 25^\circ\text{C}$ | | 8 | 10 | mA |

[‡] All typical values are at $V_{CC} = 5$ V and $T_A = 25^\circ\text{C}$.

NOTE 3: Test conditions are C1–C4 = 1 μF at $V_{CC} = 5$ V \pm 0.5 V.



MAX232, MAX232I

DUAL EIA-232 DRIVERS/RECEIVERS

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DRIVER SECTION

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature range (see Note 3)

| PARAMETER | | TEST CONDITIONS | MIN | TYP† | MAX | UNIT |
|-------------------|------------------------------|--|-----|------|-----|------|
| V _{OH} | High-level output voltage | T1OUT, T2OUT R _L = 3 kΩ to GND | 5 | 7 | | V |
| V _{OL} | Low-level output voltage‡ | T1OUT, T2OUT R _L = 3 kΩ to GND | | –7 | –5 | V |
| r _o | Output resistance | T1OUT, T2OUT V _{S+} = V _{S–} = 0, V _O = ±2 V | 300 | | | Ω |
| I _{OS} § | Short-circuit output current | T1OUT, T2OUT V _{CC} = 5.5 V, V _O = 0 | | ±10 | | mA |
| I _{IS} | Short-circuit input current | T1IN, T2IN V _I = 0 | | | 200 | μA |

† All typical values are at V_{CC} = 5 V, T_A = 25°C.

‡ The algebraic convention, in which the least positive (most negative) value is designated minimum, is used in this data sheet for logic voltage levels only.

§ Not more than one output should be shorted at a time.

NOTE 3: Test conditions are C1–C4 = 1 μF at V_{CC} = 5 V ± 0.5 V.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see Note 3)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|------------------------------------|--|-----|-----|-----|--------|
| SR | Driver slew rate | R _L = 3 kΩ to 7 kΩ, See Figure 2 | | | 30 | V/μs |
| SR(t) | Driver transition region slew rate | See Figure 3 | | 3 | | V/μs |
| | Data rate | One TOUT switching | | 120 | | kbit/s |

NOTE 3: Test conditions are C1–C4 = 1 μF at V_{CC} = 5 V ± 0.5 V.

RECEIVER SECTION

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature range (see Note 3)

| PARAMETER | | TEST CONDITIONS | MIN | TYP† | MAX | UNIT |
|------------------|---|--|-----|------|-----|------|
| V _{OH} | High-level output voltage | R1OUT, R2OUT I _{OH} = –1 mA | 3.5 | | | V |
| V _{OL} | Low-level output voltage‡ | R1OUT, R2OUT I _{OL} = 3.2 mA | | | 0.4 | V |
| V _{IT+} | Receiver positive-going input threshold voltage | R1IN, R2IN V _{CC} = 5 V, T _A = 25°C | | 1.7 | 2.4 | V |
| V _{IT–} | Receiver negative-going input threshold voltage | R1IN, R2IN V _{CC} = 5 V, T _A = 25°C | 0.8 | 1.2 | | V |
| V _{hys} | Input hysteresis voltage | R1IN, R2IN V _{CC} = 5 V | 0.2 | 0.5 | 1 | V |
| r _i | Receiver input resistance | R1IN, R2IN V _{CC} = 5, T _A = 25°C | 3 | 5 | 7 | kΩ |

† All typical values are at V_{CC} = 5 V, T_A = 25°C.

‡ The algebraic convention, in which the least positive (most negative) value is designated minimum, is used in this data sheet for logic voltage levels only.

NOTE 3: Test conditions are C1–C4 = 1 μF at V_{CC} = 5 V ± 0.5 V.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see Note 3 and Figure 1)

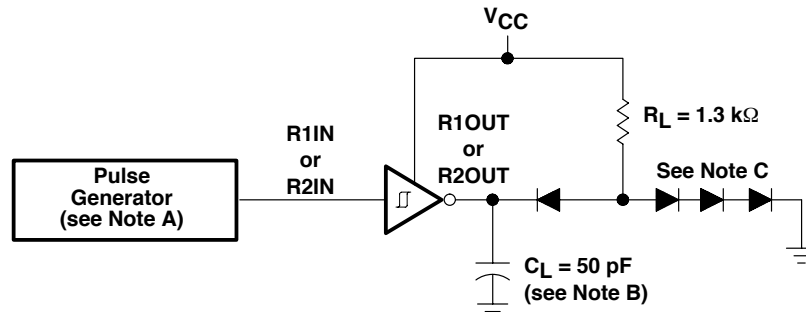
| PARAMETER | | TYP | UNIT |
|---------------------|--|-----|------|
| t _{PLH(R)} | Receiver propagation delay time, low- to high-level output | 500 | ns |
| t _{PHL(R)} | Receiver propagation delay time, high- to low-level output | 500 | ns |

NOTE 3: Test conditions are C1–C4 = 1 μF at V_{CC} = 5 V ± 0.5 V.

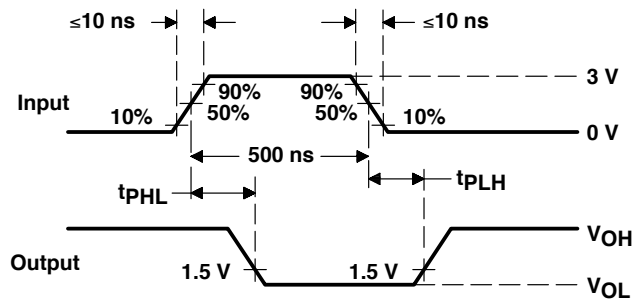


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PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



WAVEFORMS

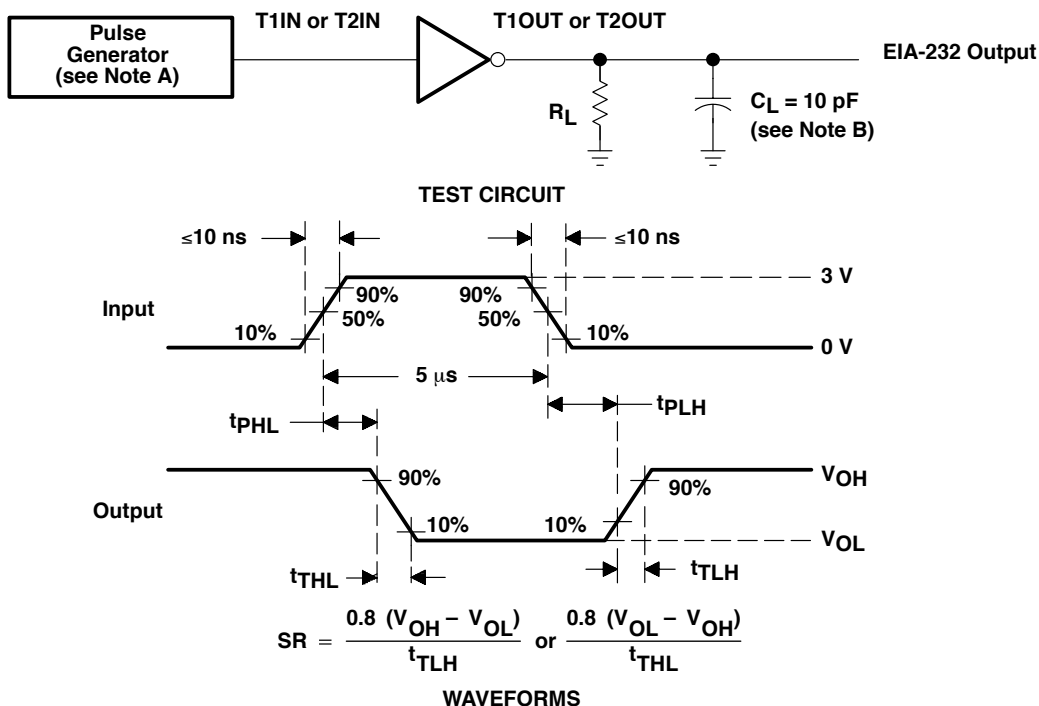
- NOTES: A. The pulse generator has the following characteristics: $Z_O = 50\ \Omega$, duty cycle $\leq 50\%$.
B. C_L includes probe and jig capacitance.
C. All diodes are 1N3064 or equivalent.

Figure 1. Receiver Test Circuit and Waveforms for t_{PHL} and t_{PLH} Measurements

MAX232, MAX232I DUAL EIA-232 DRIVERS/RECEIVERS

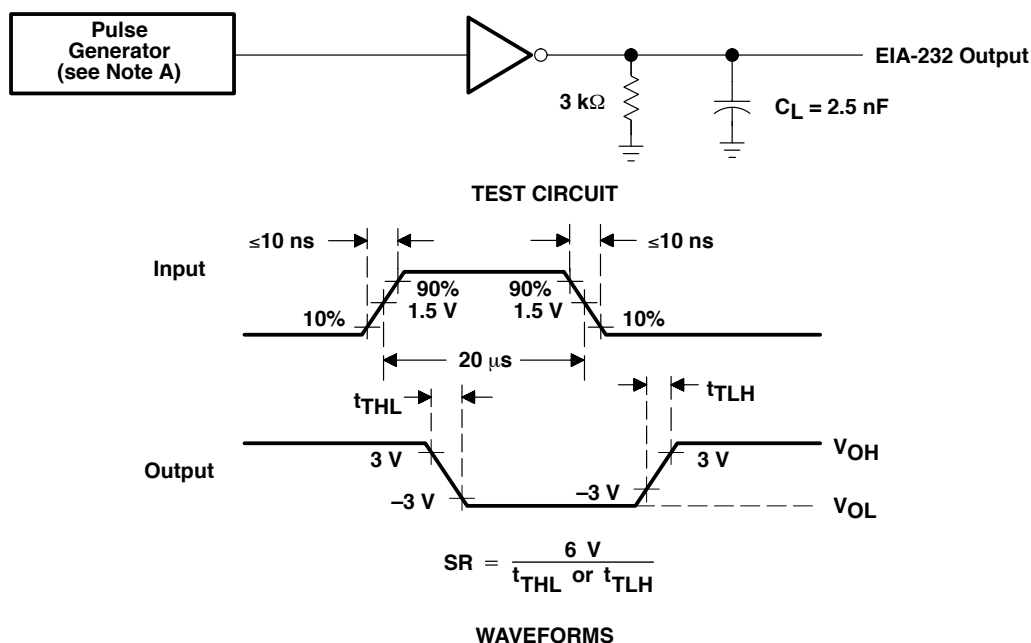
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PARAMETER MEASUREMENT INFORMATION



NOTES: A. The pulse generator has the following characteristics: $Z_O = 50 \Omega$, duty cycle $\leq 50\%$.
B. C_L includes probe and jig capacitance.

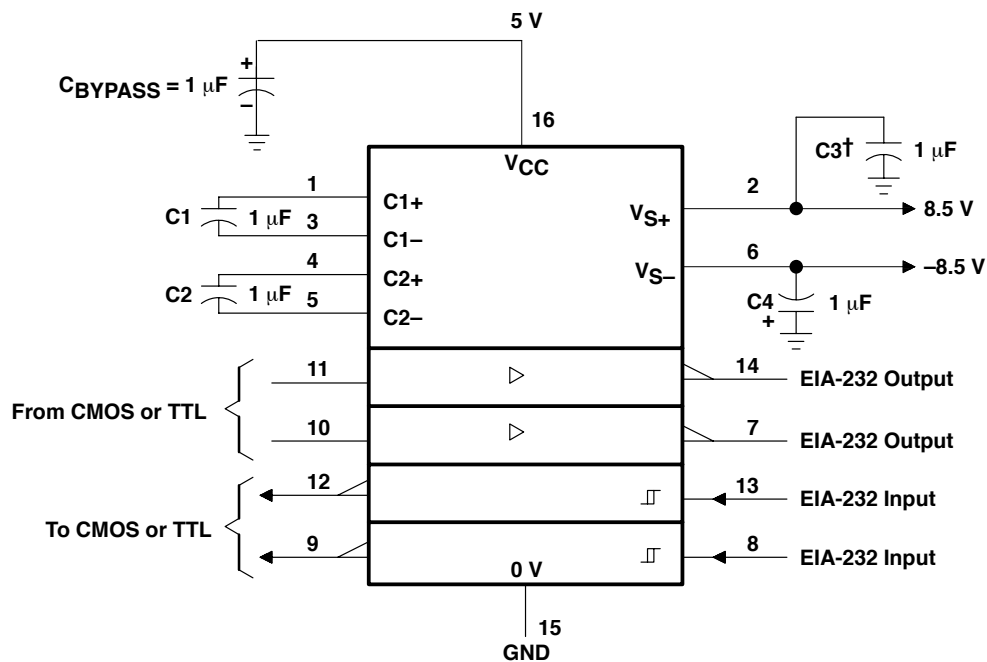
Figure 2. Driver Test Circuit and Waveforms for t_{PHL} and t_{PLH} Measurements (5- μs Input)



NOTE A: The pulse generator has the following characteristics: $Z_O = 50 \Omega$, duty cycle $\leq 50\%$.

Figure 3. Test Circuit and Waveforms for t_{THL} and t_{TLH} Measurements (20- μs Input)

APPLICATION INFORMATION



† $C3$ can be connected to V_{CC} or GND.

Figure 4. Typical Operating Circuit

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