

# MAX232, MAX232I DUAL EIA-232 DRIVER/RECEIVER

SLLS047D – FEBRUARY 1989 – REVISED MAY 1995

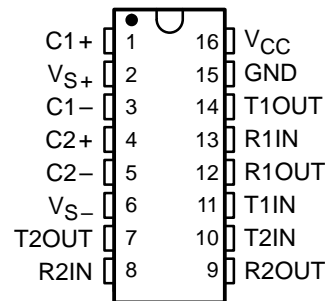
- Operates With Single 5-V Power Supply
- LinBiCMOS™ Process Technology
- Two Drivers and Two Receivers
- $\pm 30$ -V Input Levels
- Low Supply Current . . . 8 mA Typ
- Meets or Exceeds ANSI EIA/TIA-232-E and ITU Recommendation V.28
- Designed to be Interchangeable With Maxim MAX232
- Applications
  - EIA/TIA-232-E
  - Battery-Powered Systems
  - Terminals
  - Modems
  - Computers
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015

## description

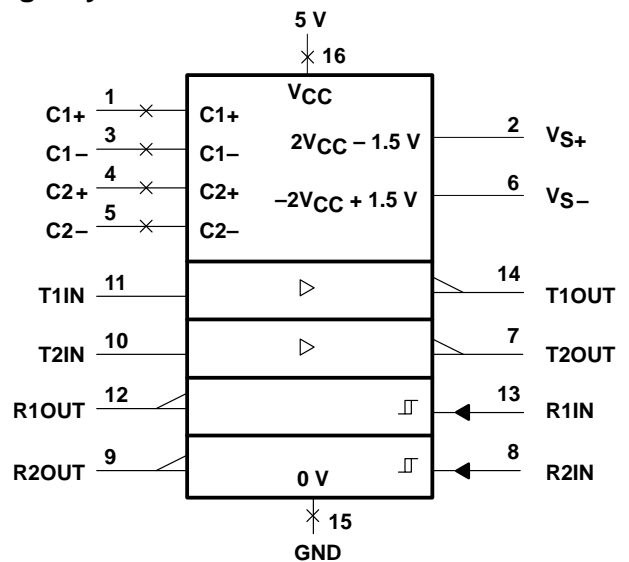
The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply EIA/TIA-232-E voltage levels from a single 5-V supply. Each receiver converts EIA/TIA-232-E inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V and a typical hysteresis of 0.5 V, and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

The MAX232 is characterized for operation from 0°C to 70°C. The MAX232I is characterized for operation from -40°C to 85°C.

DW OR N PACKAGE  
(TOP VIEW)



## logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

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# MAX232, MAX232I

## DUAL EIA-232 DRIVER/RECEIVER

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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	$\pm 30$ 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
Operating free-air temperature range, $T_A$ : MAX232	0°C to 70°C
MAX232I	–40°C to 85°C
Storage temperature range, $T_{stg}$	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°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.

### recommended operating conditions

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

### electrical characteristics over recommended ranges of supply voltage and operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
$V_{OH}$ High-level output voltage	T1OUT, T2OUT	$R_L = 3$ k $\Omega$ to GND	5	7		V
	R1OUT, R2OUT	$I_{OH} = -1$ mA	3.5			
$V_{OL}$ Low-level output voltage‡	T1OUT, T2OUT	$R_L = 3$ k $\Omega$ to GND		–7	–5	V
	R1OUT, R2OUT	$I_{OL} = 3.2$ mA			0.4	
$V_{IT+}$ Receiver positive-going input threshold voltage	R1IN, R2IN	$V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$		1.7	2.4	V
$V_{IT-}$ Receiver negative-going input threshold voltage	R1IN, R2IN	$V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$	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	$V_{CC} = 5$ , $T_A = 25^\circ\text{C}$	3	5	7	k $\Omega$
$r_o$ Output resistance	T1OUT, T2OUT	$V_{S+} = V_{S-} = 0$ , $V_O = \pm 2$ V	300			$\Omega$
$I_{OS}^{\S}$ Short-circuit output current	T1OUT, T2OUT	$V_{CC} = 5.5$ V, $V_O = 0$		$\pm 10$		mA
$I_{IS}$ Short-circuit input current	T1IN, T2IN	$V_I = 0$			200	$\mu\text{A}$
$I_{CC}$ Supply current		$V_{CC} = 5.5$ V, $T_A = 25^\circ\text{C}$ , All outputs open,		8	10	mA

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

‡ 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.



switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH(R)}$ Receiver propagation delay time, low- to high-level output	See Figure 2		500		ns
$t_{PHL(R)}$ Receiver propagation delay time, high- to low-level output	See Figure 2		500		ns
SR Driver slew rate	$R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$ , See Figure 3			30	$\text{V}/\mu\text{s}$
SR(tr) Driver transition region slew rate	See Figure 4		3		$\text{V}/\mu\text{s}$

APPLICATION INFORMATION

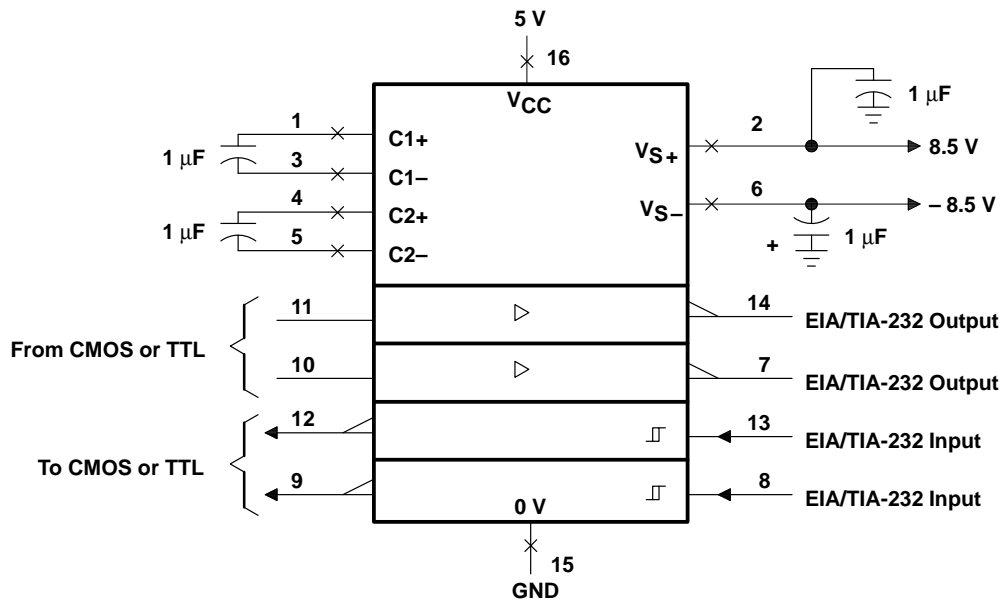
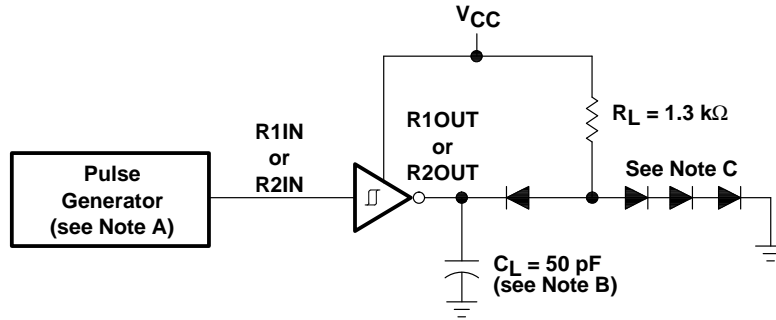


Figure 1. Typical Operating Circuit

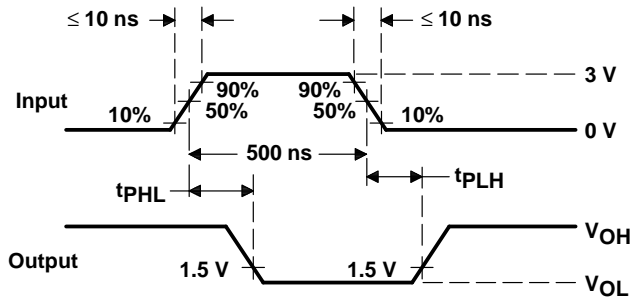
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## PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

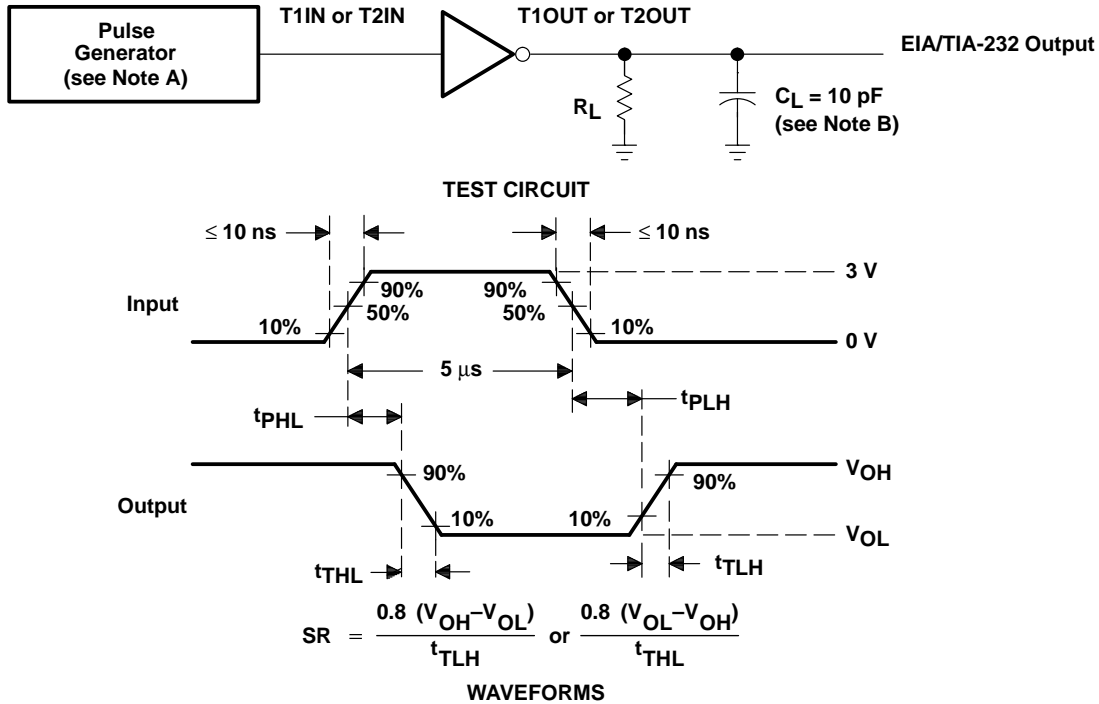


WAVEFORMS

- 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.

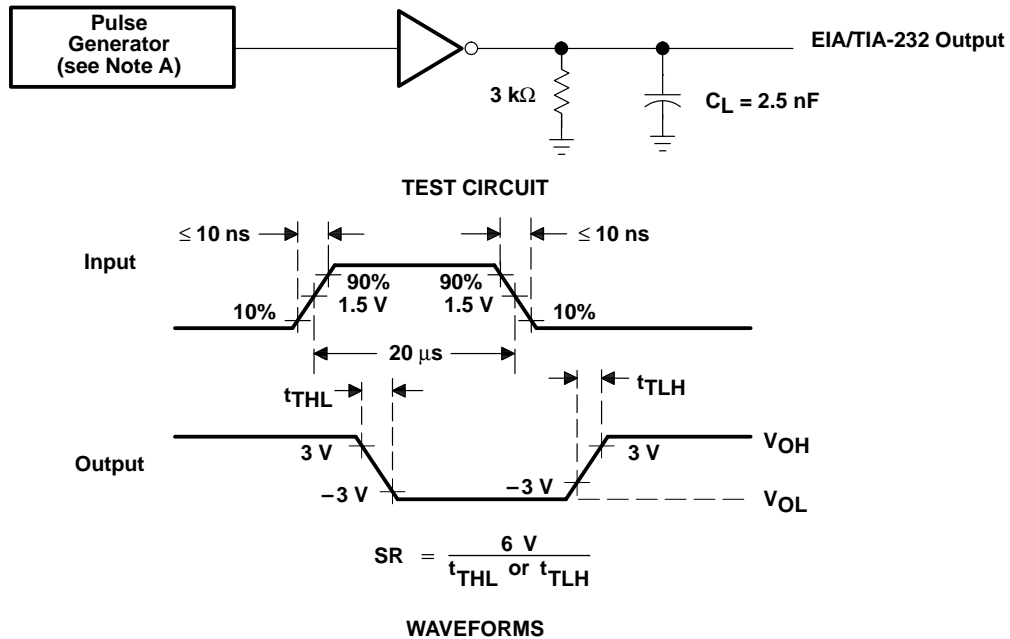
Figure 2. Receiver Test Circuit and Waveforms for  $t_{PHL}$  and  $t_{PLH}$  Measurement

PARAMETER MEASUREMENT INFORMATION



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

Figure 3. Driver Test Circuit and Waveforms for  $t_{PHL}$  and  $t_{PLH}$  Measurement (5- $\mu\text{s}$  input)



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

Figure 4. Test Circuit and Waveforms for  $t_{THL}$  and  $t_{TLH}$  Measurement (20- $\mu\text{s}$  input)



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