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# MAX232, MAX232I DUAL EIA-232 DRIVER/RECEIVER

SLLS047G – FEBRUARY 1989 – REVISED AUGUST 1998

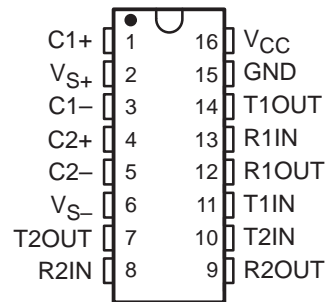
- Operates With Single 5-V Power Supply
- LinBiCMOS™ Process Technology
- Two Drivers and Two Receivers
- ±30-V Input Levels
- Low Supply Current . . . 8 mA Typical
- Meets or Exceeds TIA/EIA-232-F and ITU Recommendation V.28
- Designed to be Interchangeable With Maxim MAX232
- Applications
  - TIA/EIA-232-F
  - Battery-Powered Systems
  - Terminals
  - Modems
  - Computers
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015
- Package Options Include Plastic Small-Outline (D, DW) Packages and Standard Plastic (N) DIPs

## description

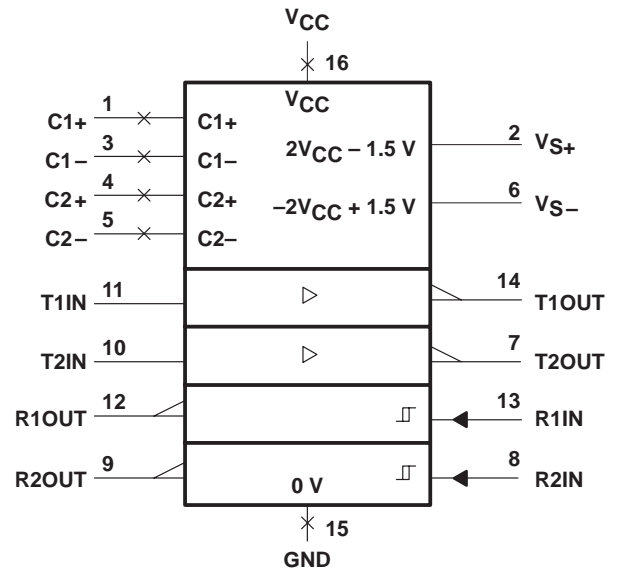
The MAX232 device is a dual driver/receiver that includes a capacitive voltage generator to supply EIA-232 voltage levels from a single 5-V supply. Each receiver converts EIA-232 inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V and a typical hysteresis of 0.5 V, and can 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.

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

D, DW, OR N PACKAGE  
(TOP VIEW)



logic symbol†



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

## AVAILABLE OPTIONS

T <sub>A</sub>	PACKAGED DEVICES		
	SMALL OUTLINE (D)	SMALL OUTLINE (DW)	PLASTIC DIP (N)
0°C to 70°C	MAX232D‡	MAX232DW‡	MAX232N
-40°C to 85°C	MAX232ID‡	MAX232IDW‡	MAX232IN

‡ This device is available taped and reeled by adding an R to the part number (i.e., MAX232DR).



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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
Package thermal impedance, $\theta_{JA}$ (see Note 2): D package	.....	113°C/W
DW package	.....	105°C/W
N package	.....	78°C/W
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.

2. The package thermal impedance is calculated in accordance with JESD 51, except for through-hole packages, which use a trace length of zero.

## 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, $T_A$	MAX232	0		70	°C
	MAX232I	-40		85	



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 <sub>OH</sub>	High-level output voltage	T1OUT, T2OUT	R <sub>L</sub> = 3 kΩ to GND		5	7	V	
		R1OUT, R2OUT	I <sub>OH</sub> = -1 mA		3.5			
V <sub>OL</sub>	Low-level output voltage‡	T1OUT, T2OUT	R <sub>L</sub> = 3 kΩ to GND		-7	-5	V	
		R1OUT, R2OUT	I <sub>OL</sub> = 3.2 mA		0.4			
V <sub>IT+</sub>	Receiver positive-going input threshold voltage	R1IN, R2IN	V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C		1.7	2.4	V	
V <sub>IT-</sub>	Receiver negative-going input threshold voltage	R1IN, R2IN	V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C		0.8	1.2	V	
V <sub>hys</sub>	Input hysteresis voltage	R1IN, R2IN	V <sub>CC</sub> = 5 V		0.2	0.5	1	V
r <sub>i</sub>	Receiver input resistance	R1IN, R2IN	V <sub>CC</sub> = 5, T <sub>A</sub> = 25°C		3	5	7	kΩ
r <sub>o</sub>	Output resistance	T1OUT, T2OUT	V <sub>S+</sub> = V <sub>S-</sub> = 0, V <sub>O</sub> = ± 2 V		300		Ω	
I <sub>OS</sub> §	Short-circuit output current	T1OUT, T2OUT	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0		±10		mA	
I <sub>IS</sub>	Short-circuit input current	T1IN, T2IN	V <sub>I</sub> = 0		200		μA	
I <sub>CC</sub>	Supply current	V <sub>CC</sub> = 5.5 V, T <sub>A</sub> = 25°C		All outputs open,		8	10	mA

† All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 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.

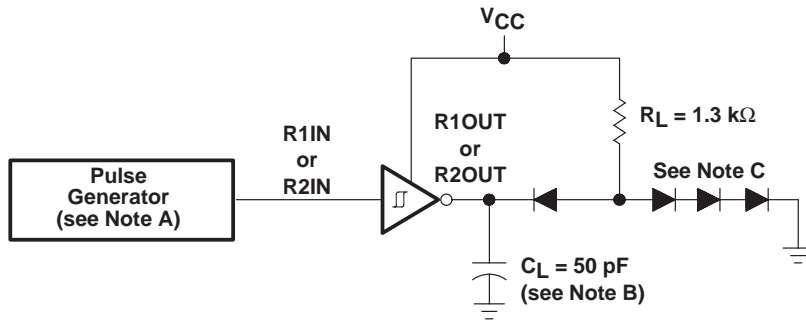
### switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t <sub>PLH(R)</sub>	Receiver propagation delay time, low- to high-level output	See Figure 1	500			ns
t <sub>PHL(R)</sub>	Receiver propagation delay time, high- to low-level output	See Figure 1	500			ns
SR	Driver slew rate	R <sub>L</sub> = 3 kΩ to 7 kΩ, See Figure 2			30	V/μs
SR(tr)	Driver transition region slew rate	See Figure 3	3			V/μs

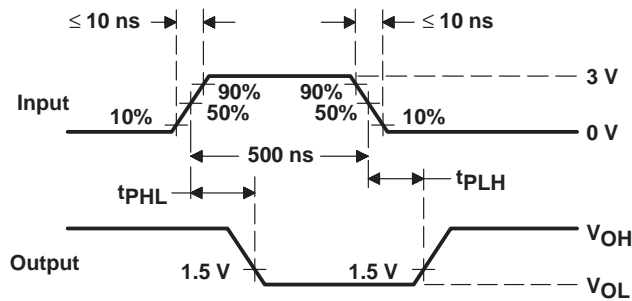
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## PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

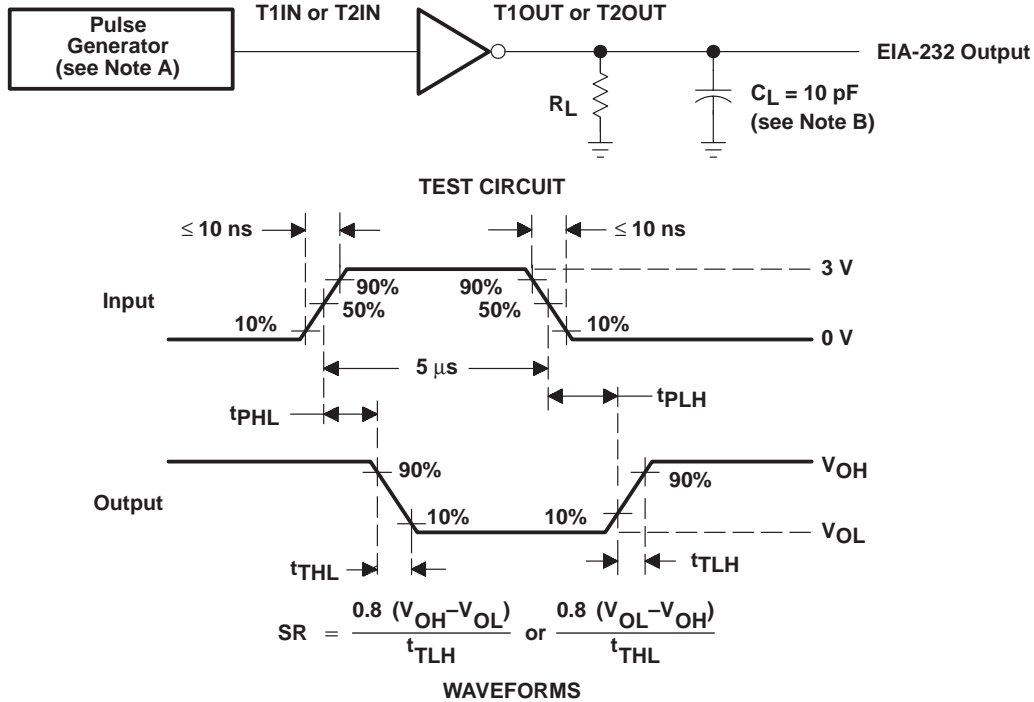


WAVEFORMS

- 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.

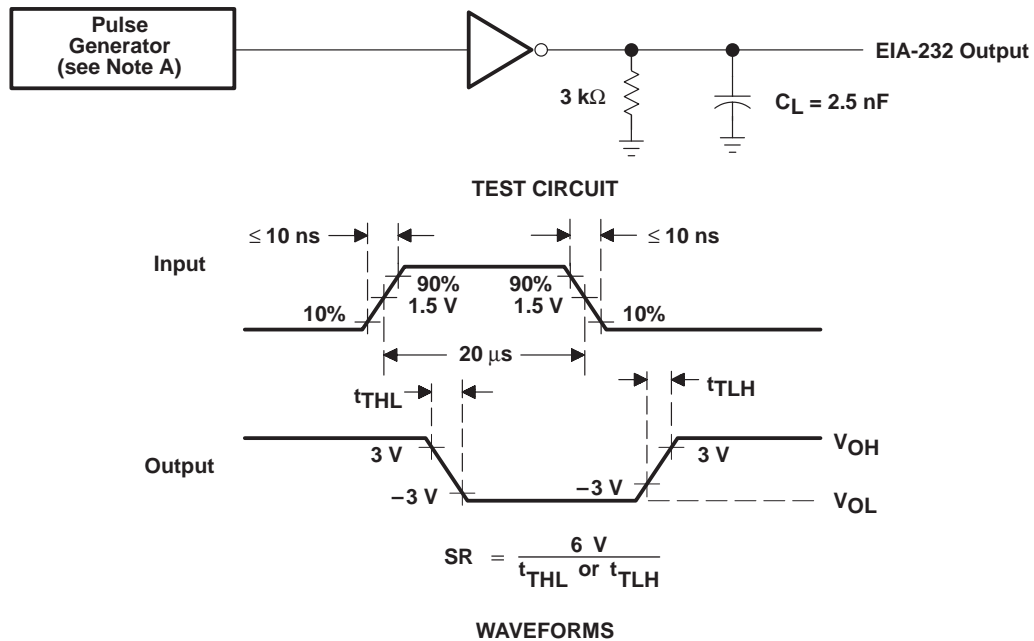
Figure 1. Receiver Test Circuit and Waveforms for  $t_{PHL}$  and  $t_{PLH}$  Measurements

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- $\mu\text{s}$  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- $\mu\text{s}$  input)

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## APPLICATION INFORMATION

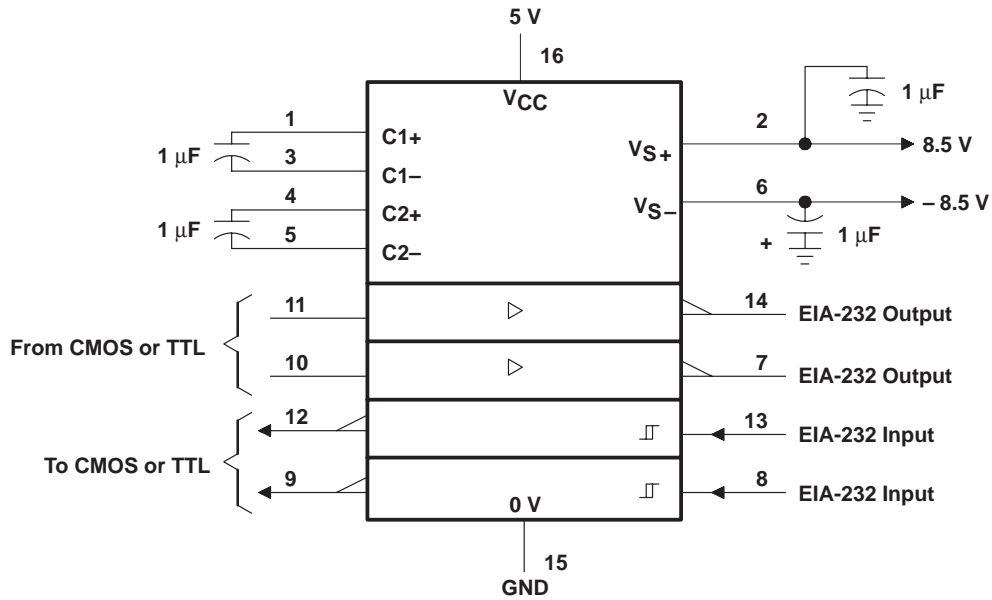


Figure 4. Typical Operating Circuit

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