MAX232
+5V Powered, Dual RS-232 Drivers/Receivers

DESCRIPTION

The MAX232 is a dual RS-232 driver/receiver interface circuit that meets all EIA RS-232C and V.28 specifications. It requires a single +5V power supply, and features two onboard charge pump voltage converters which generate +10V and -10V supplies from the 5V supply.

The drivers feature true TTL/CMOS input compatibility, slew-rate-limited output, and 300Ω power-off source impedance. The receivers can handle up to ±30V, and have a 3kΩ to 7kΩ input impedance. The receivers also have hysteresis to improve noise rejection.

FEATURES

- 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 and TI MAX232, ICL232, SP232
- ESD Protection Exceeds JESD 22

- C 2000-V Human-Body Model (A114-A)

APPLICATIONS

- Any System Requiring RS-232 Communications Port

- Computer - Portable and Mainframe
- Peripheral - Printers and Terminals
- Portable Instrumentation
- Modems

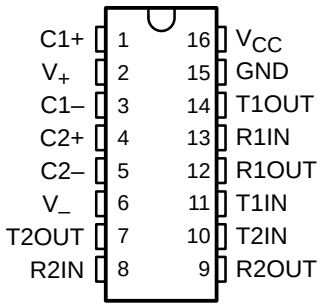
- Dataloggers

ORDERING INFORMATION

PART NO.	Temp. Range (°C)	Package
MAX232CPE	0 to 70	16 Pin DIP
MAX232CSE	0 to 70	16 Pin Narrow SO
MAX232EPE	-40 to 85	16 Pin DIP
MAX232ESE	-40 to 85	16 Pin Narrow SO

PINOUT

MAX232 (DIP, SOIC)
(TOP VIEW)



PIN DESCRIPTIONS

Pin No.	PIN NAME	DESCRIPTION
01	C1+	External capacitor "+" for internal voltage doubler.
02	V+	Internally generated +10V (typical) supply.
03	C1-	External capacitor "-" for internal voltage doubler.
04	C2+	External capacitor "+" internal voltage inverter.
05	C2-	External capacitor "-" internal voltage inverter.
06	V-	Internally generated -10V (typical) supply.
07	$T2_{OUT}$	RS-232 Driver (Transmitter) 2 output ±10V (typical).
08	$R2_{IN}$	RS-232 Receiver 2 input, with internal 5K pulldown resistor to GND.
09	$R2_{OUT}$	Receiver 2 TTL/CMOS output.
10	$T2_{IN}$	Driver (Transmitter) 2 TTL/CMOS input.
11	$T1_{IN}$	Driver (Transmitter) 1 TTL/CMOS input.
12	$R1_{OUT}$	Receiver 1 TTL/CMOS output.
13	$R1_{IN}$	RS-232 Receiver 1 input, with internal 5K pulldown resistor to GND.
14	$T1_{OUT}$	RS-232 Driver (Transmitter) 1 output ± 10V (typical).
15	GND	Supply Ground.
16	V_{CC}	Positive Power Supply +5V ±10%

Function Tables

EACH DRIVER

INPUT TIN	OUTPUT TOUT
L	H
H	L

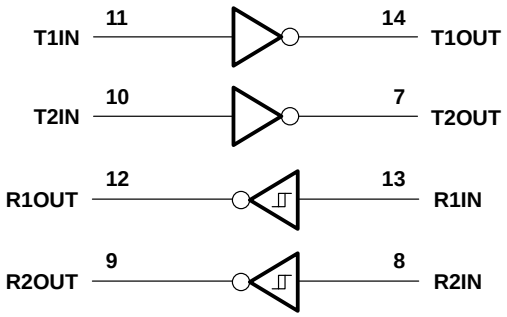
H = high level, L = low level

EACH RECEIVER

INPUT RIN	OUTPUT ROUT
L	H
H	L

H = high level, L = low level

Logic diagram (positive logic)



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_+ . . . . . V_{CC} – 0.3 V to 14 V
Negative output supply voltage range, V_- . . . . . –0.3 V to –14 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): SO package . . . . . 73°C/W
DIP package . . . . . 67°C/W
SO W package . . . . . 57°C/W
CERDIP package . . . . . 54°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 measured with the component mounted on an evaluation PC board in free air.

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	MAX232C	0		70	°C
		MAX232E	–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°C		8	10	mA

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

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

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_0	Output resistance	T1OUT, T2OUT	$V_+ = V_- = 0$,	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
RI	Receiver input resistance	R1IN, R2IN	V_{CC} = 5,	T_A = 25°C	3	5	7	kΩ

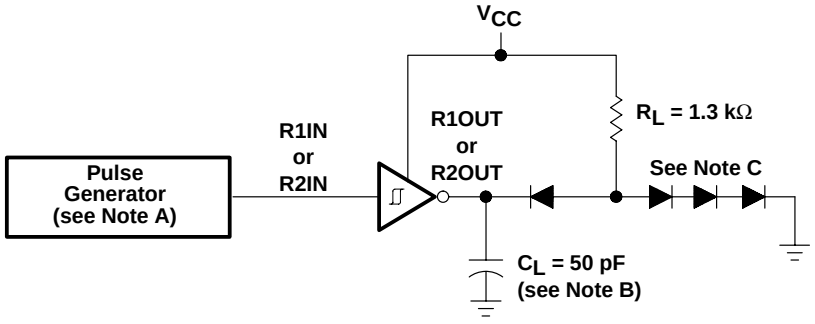
† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ The algebraic convention, in which the least positive (most negative) value is designated minimum, is used in this data sheet for logic voltage levels only.
NOTE 3: Test conditions are C1–C4 = 1 µF at V_{CC} = 5 V ± 0.5 V.

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

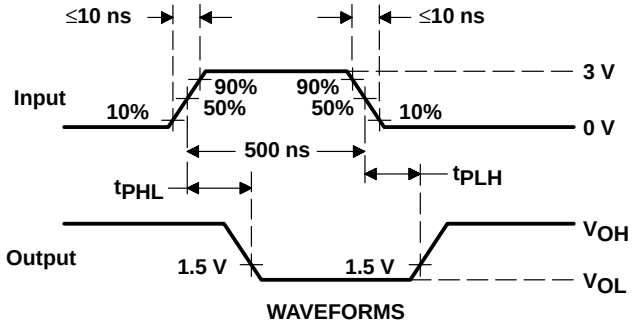
PARAMETER		TYP	UNIT
$t_{PLH(R)}$	Receiver propagation delay time, low- to high-level output	500	ns
$t_{PHL(R)}$	Receiver propagation delay time, high- to low-level output	500	ns

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

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

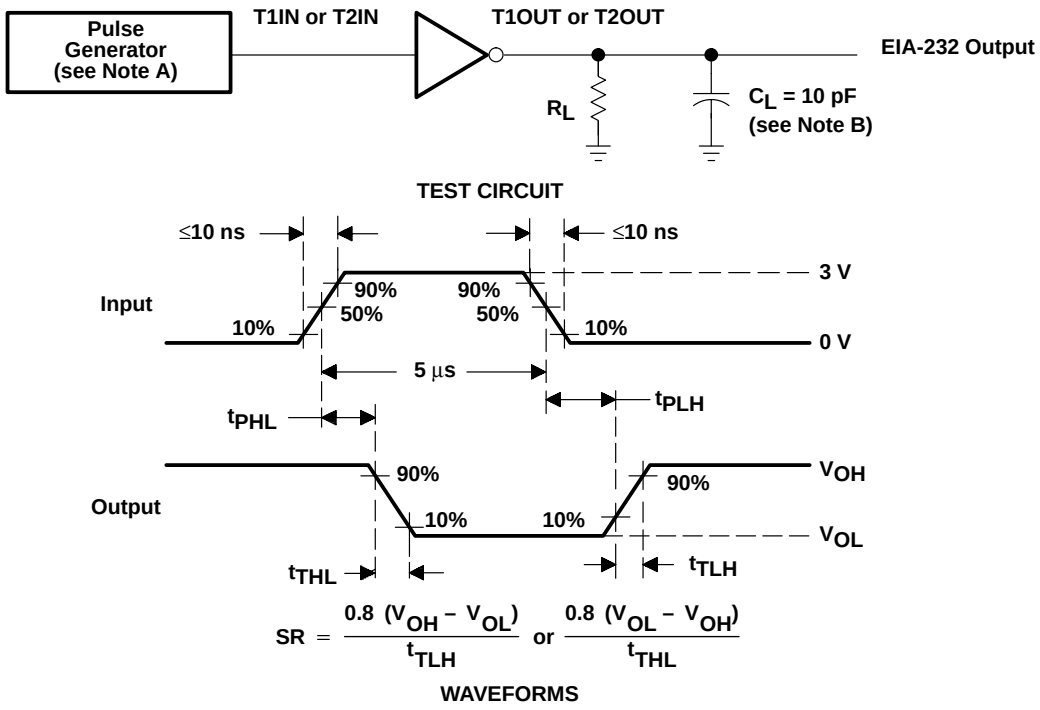


WAVEFORMS

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

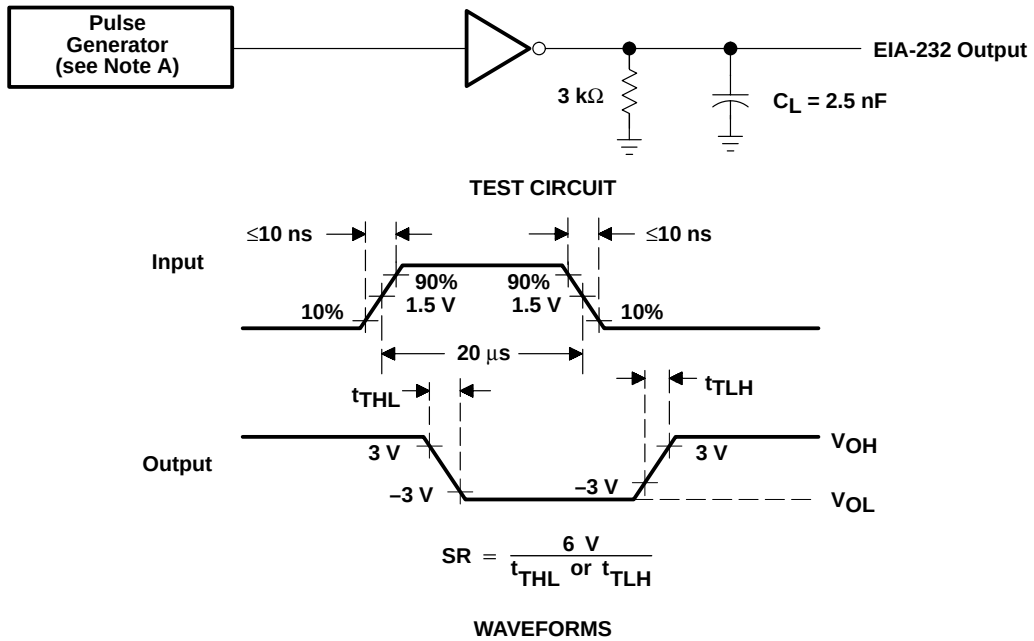
Figure 1. Receiver Test Circuit and Waveforms for t_{PHL} and t_{PLH} Measurements

PARAMETER MEASUREMENT INFORMATION



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

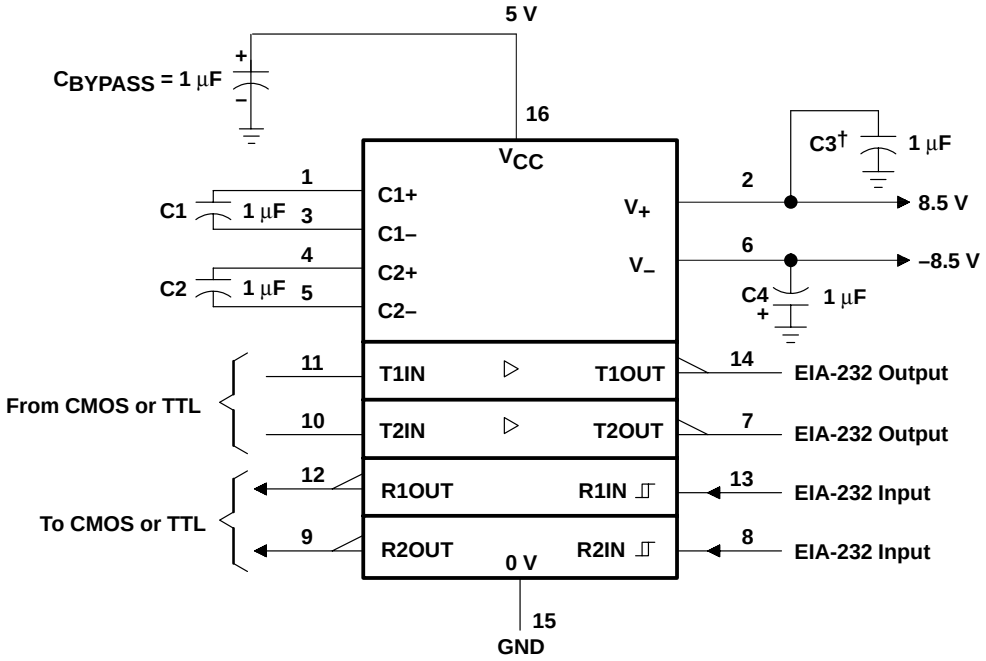
Figure 2. Driver Test Circuit and Waveforms for t_{PHL} and t_{PLH} Measurements (5-µs Input)



NOTE A: The pulse generator has the following characteristics: Z_O = 50 Ω, duty cycle ≤ 50%.

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

APPLICATION INFORMATION



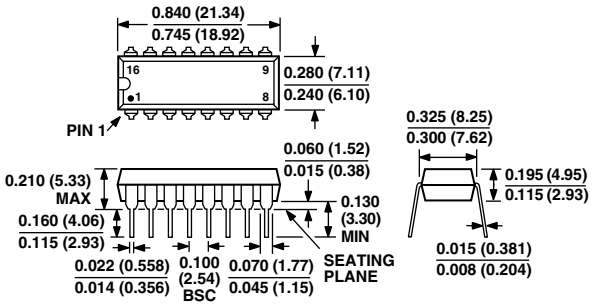
† C3 can be connected to V_{CC} or GND.

Figure 4. Typical Operating Circuit

OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

16-Lead Plastic DIP



16-Lead Narrow SOIC