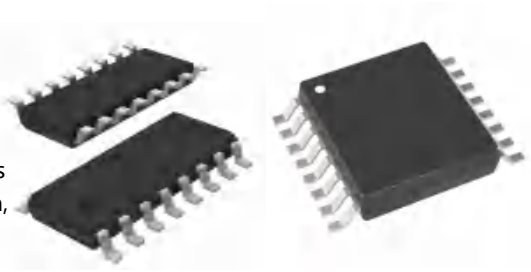
HX3232-S/HX3232-ST
Multi channel RS-232 line driver and receiver circuit

The HX3232-S/HX3232-ST series interface chip adopts 3.3V power supply, meets EIA/TIA-232 and CCITT V.28/V.24 communication standards, and has low power consumption characteristics. It integrates two drivers, two receivers, and a dedicated switch capacitor voltage regulator converter internally. Within the power supply range of 3V to 5.5V, this series of devices can ensure a data transmission rate of up to 250kbit/s. In addition, all RS232 I/O pins have excellent electrostatic discharge (ESD) protection capabilities, which far exceed the ± 15kV air discharge and ± 8kV contact discharge requirements specified in the EN61000-4-2 standard.



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Characteristic

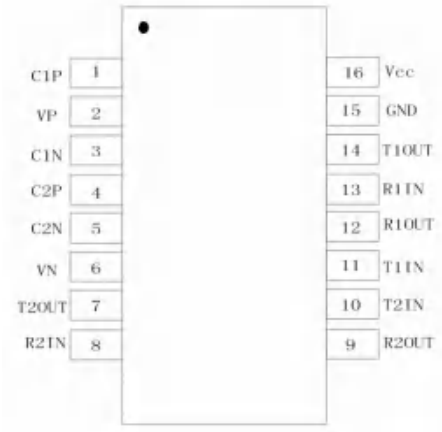
- HX3232-S/HX3232-ST meets the communication requirements of EIA/TIA-232F and CCITT V.28/V.24 protocols when powered by 3.3V or 5V.
- Low static working current: typical value of 0.5mA, maximum value of 1mA.
- Ensure a data transmission rate of 250kbps.
- Low turn off current: typical value of 1uA,maximum value of 10uA.
- Specialized switch capacitor voltage converter.
- ESD protection for RS-232 I/O.

15KV Human Body Model （HBM）
15KV EN61000-4-2 Air Gap Discharge
8KV EN61000-4-2 Contact Discharge

Application

- Battery powered devices and handheld devices
- Laptops and handheld computers
- Terminal adapter and POS terminal
- Cellular telephone data cable
- Modems

Pin diagram and pin description



Chip pin description		
Pin	Name	Function
1	C1P	Positive terminal of boost charge pump capacitor
2	VP	The+5.3V voltage generated by the charge pump
3	C1N	Negative terminal of boost charge pump capacitor
4	C2P	Positive terminal of reverse charge pump capacitor
5	C2N	Negative terminal of reverse charge pump capacitor
6	VN	-5.3V voltage generated by charge pump
7	T2OUT	Second RS232 driver output
8	R2IN	Second RS232 receiver input
9	R2OUT	The output of the second TTL/CMOS receiver
10	T2IN	Second TTL/CMOS driver input
11	T1IN	The first TTL/CMOS driver input
12	R1OUT	The first TTL/CMOS receiver output
13	R1IN	The first RS232 receiver input
14	T1OUT	The first RS232 driver output
15	GND	Ground
16	VCC	Power supply

Electrical characteristics
Limit parameter

Parameter	Price	Unit
Vcc	-0.3~+6.0	V
VP	-0.3~+7.0	V
VN	+0.3~-7.0	V
|VP|+|VN|	+13	V
I_{CC}	±100	mA
TxIN	-0.3~+6.0	V
RxIN	±20	V
TxOUT	±15	V
RxOUT	-0.3~(VCC +0.3)	V
Operation temperature	-40~+85	℃
Storage temperature	-65~+150	℃

Electrical characteristics

Unless otherwise specified, VCC=3.0V to 5.0V, TA=Tmin to Tmax, C1 to C5=0.1uF, typical application conditions are VCC=3.3V or VCC=5.0V, TA=25 ℃.

Parameter	Condition	Min	Typ	Max	Unit
Charge pump capacitor	C1P,C1N,C2P,C2N	0.1	0.1	1	uF
Temperature range from 0 ℃ to 70 ℃	Commercial	0	25	70	℃
Temperature -40 ℃ to 85 ℃	Industrial grade	-40	25	85	℃
Supply voltage	VCC=5.0V	4.5	5	5.5	V
	VCC=3.3V	3	3.3	3.6	V
Working current	TTL input= VCC/GND, RS-232		0.5	1	mA
Drive input					
Input threshold voltage low	VCC= +5.0V			0.8	V
	VCC= +3.3V			0.8	V
Input threshold voltage high	VCC= +5.0V	2.4			V
	VCC= +3.3V	2.4			V
Input threshold voltage hysteresis	VCC= +5.0V		0.5		V
	VCC= +3.3V		0.5		V
Input leakage current	VIN = VCC and GND,		±0.01	±1	uA
Receiver output					
Low output voltage	VCC=+5.0V,IOUT=1.6mA			0.4	V
	VCC= +3.3V,IOUT=1.6mA			0.4	V
Output voltage high	VCC=+5.0V,IOUT=-1.0mA	VCC-0.6	VCC-0.1		V
	VCC=+3.3V,IOUT=-1.0mA	VCC-0.6	VCC-0.1		V
Output leakage current	Receiver output suspended, VOUT=VCC or		±0.05	±10	uA
Receiver Input					
Input voltage swing	TA=Tmin-Tmax	-20		+20	V
Input threshold voltage low	TA=25℃, VCC= 5.0V	0.8	1.5		V
	TA=25℃, VCC= 3.3V	0.6	1.2		V
Input threshold voltage high	TA=25℃, VCC= 5.0V			2.4	V
	TA=25℃, VCC= 3.3V			2.4	V
Input threshold voltage hysteresis	TA=25℃, VCC= 5.0V		0.5		V
	TA=25℃, VCC= 3.3V		0.5		V
Input Resistance	Vin=±20V, TA=25℃		5		KΩ

Driver output					
Output voltage amplitude	RL=3 KΩ,Output with load	±5			V
output resistance	VCC=VP=VN=GND,Vout=±2V	300			Ω
Output short circuit current	VOUT=GND			±60	mA
Output leakage current	Drive not working Vout=±12V		±5		uA
Maximum data transmission rate	RL=3 KΩ,CL=1000pF,	250			kbps
Transmission limit swing rate	RL=3~7KΩ,Cl=150-1000p,	6		30	V/us
Receiver input/output delay	CL=150pF Figure 3		0.15		us
The difference between the input and output delay of the receiver	TPHL-TPLH Figure 3		50		ns
ESD protection capability					
ESD HBM	RS-232 input and output			±15	KV
EN61000-4-2ContactDischarge	RS-232 input and output			±8	KV
EN61000-4-2ContactDischarge	RS-232 input and output			±15	KV

Function Description

Specialized switch capacitor voltage converter

The HX3232-S/HX3232-ST uses a unique two-way switch capacitor design for powerful bipolar voltage output. It maintains EIA/RS232 standard voltage even with power supply fluctuations. Inside, it has a stabilized oscillator, two-phase clock cycles, stable MOS switches, fast diodes, and capacitors. The bidirectional current generator uses unique complementary MOS switch and fast diode technology, combined with high-voltage processes, achieving over 70% efficiency. The switching frequency adjusts with the load via an internal oscillator. The switched capacitor pump provides a higher negative buck voltage than positive boost, balancing voltage control through load adjustment, ensuring stable bipolar supply.

The HX3322-S/HX3322-ST interface family enhances energy efficiency and ensures stable voltage output, fully compliant with EIA/RS232 standards. It integrates a protection circuit, eliminating the need for an additional costly TVS circuit. Additionally, our RS232 transceivers feature built-in transient voltage suppression circuits that meet MIL-STD-883 standards and pass mannequin HBM and EN61000-4-2 air/contact discharge tests without requiring an external ESD circuit. Mannequins are recognized in the industry as an effective semiconductor ESD testing method, particularly suitable for low-power products.

ESD Protective circuit

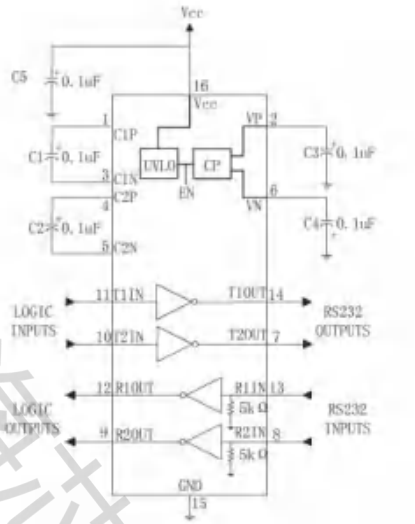
Electrostatic discharge (ESD) is a critical consideration in serial port applications. It is essential to provide adequate ESD protection for the system. RS232 transceiver devices are directly exposed to the external environment, making them vulnerable to various factors that can impact serial port stability, including transient voltages that may damage the transceiver.

Usually, RS232 transceivers connect to the transceiver IC via metal leads on a printed circuit board from a serial port connector. These leads have resistance that limits transient current and protects the IC. To further enhance voltage protection, additional devices like transient voltage suppressors (TVS) or back-to-back diode array clamps (transzorbs) are often needed for serial port circuit safety.

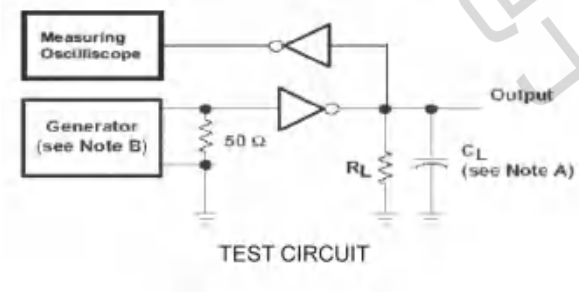
To cut costs, we integrate more ESD protection into our products. We use a test that mimics human-caused ESD discharge to assess ICs' tolerance during normal contact.

The EN61000-4-2 standard tests ESD protection of equipment and systems. Manufacturers must ensure sufficient ESD protection as systems are exposed to external environments and human factors. The standard requires systems to withstand static electricity when ESD occurs on metal points or during normal use. When ESD hits connector pins, the transceiver IC bears most of the current. The standard includes air and contact discharge tests: air discharge simulates high-energy discharge before cable connection, while contact discharge directly applies ESD current, reducing unpredictability. Air discharge test voltage is +15kV, and contact discharge is +8kV.

Typical application circuit



Typical test circuit



Maximum speed test circuit note:

A. Load resistance RL=3k Ω, load capacitance CL =1000pF, operating temperature TA=25 ° C, one driver working

B. The waveform generator requires the following parameter characteristics: Transmission rate PRR=250kbps, impedance Zo =50 Ω, duty cycle 50%, rise (tr) and fall (tf) time less than 10ns

C. XSD= VCC

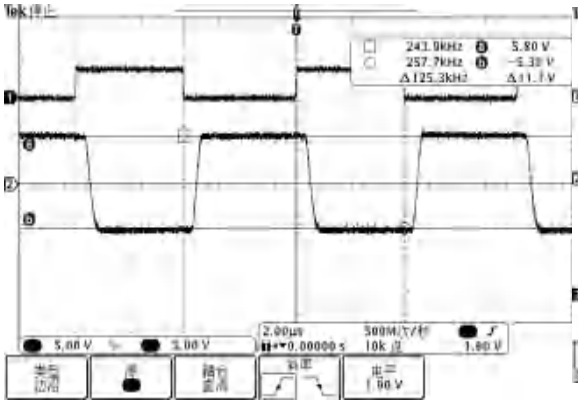


Figure 1. HX3232-S/HX3232-ST Driver Input and Output Waveforms at 250kbps (No Load)

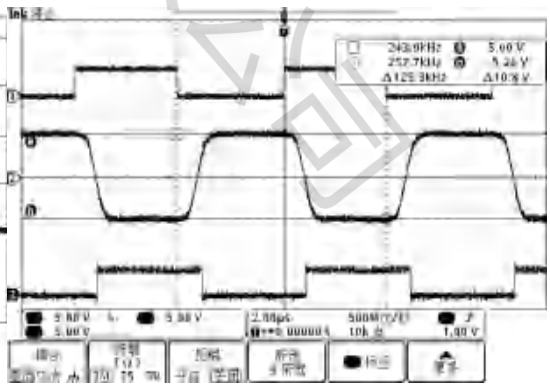


Figure 2. HX3232-S/HX3232-ST driver input to driver output to receiver output waveform at a rate of 250kbps (driver output port connected to receiver input port and 1000pF capacitor load connected to ground)

RS232 signal characteristics

Figure 1 shows how the RS232 transceiver works. When a TTL/CMOS signal goes into the driver (channel 1), we see the driver's output on channel 2. This is the open-circuit output, meaning there's no load. The charge pump converter helps the driver output near the ideal 5.8V.

Figure 2 shows the transceiver's function with a specific load. Again, TTL/CMOS signals enter the driver (channel 1), and the driver's output appears on channel 2. With a 3K Ω and 1000pF load, the R S232 signal behaves as shown. The resistive load represents the receiver's input impedance. Channel 3 shows the receiver's TTL/CMOS output.

It is worth noting that when the load is a typical RS232 load, at a transmission rate of up to 250kbps, the output level of the driver only drops by 0.2V compared to its open circuit voltage. This indicates that even under high-speed transmission conditions, the RS-232 driver output on channel 2 still maintains signal integrity, which is crucial for the receiver to minimize slope and delay when processing signals. The HX3232-S/HX3232-ST series, with its low dropout drive circuit and efficient voltage regulator, not only provides excellent line driving capability, but also has+15KV ESD shock resistance, ensuring stable performance in various environments.

Test Circuit 1

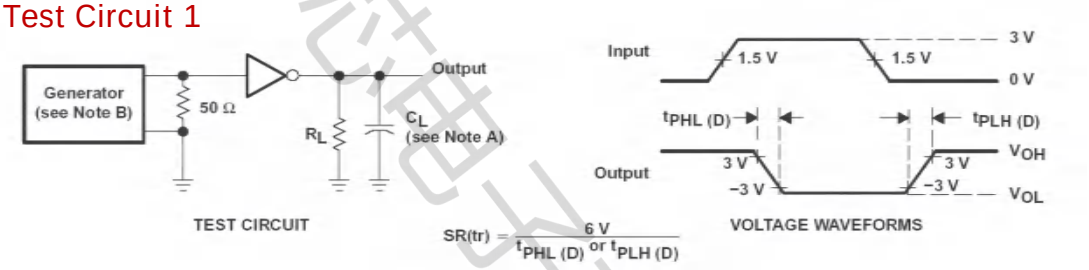


Figure 3. Driver Transmission Conversion Rate Test Circuit

A.The peripheral circuit of the chip meets the following conditions: load resistance RL=3k-7k Ω, load capacitance CL=150pF-1000pF, only one driver is working, operating temperature TA=25 ° C

B.The pulse generator has the following characteristics: transmission rate PRR=50 kbps, impedance Zo=50 Ω, duty cycle of 50%, rise time (tr) and fall time (tf) less than 10ns

C.Measurement range: from+3V to -3V or from -3V to+3V

Test Circuit 2

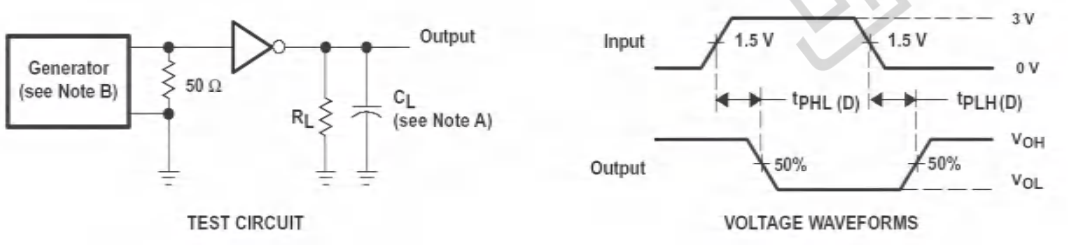


Figure 4 Test circuit for driver transmission delays tPHL and tPLH

A.All drivers are connected to the following loads: load resistance RL=3k Ω, load capacitance CL=1000pF

B. The pulse generator has the following characteristics: transmission rate PRR=50kbps, impedance Zo=50 Ω, duty cycle of 50%, rise time (tr) and fall time (tf) less than 10ns

Test Circuit 3

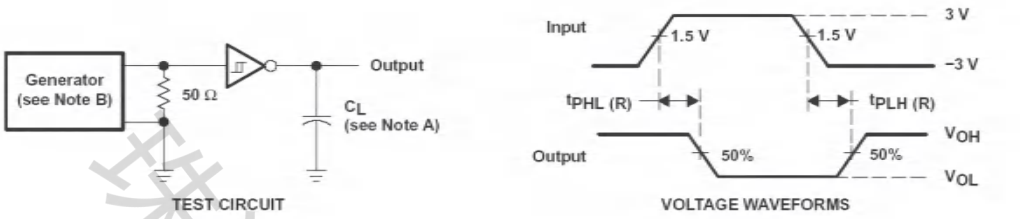
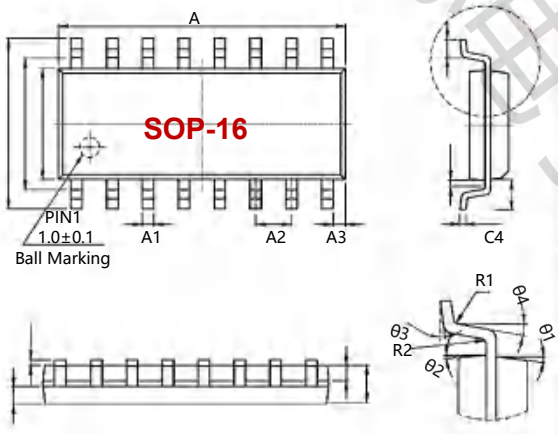


Figure 5. Test circuit for receiver transmission delay time tPHL and tPLH

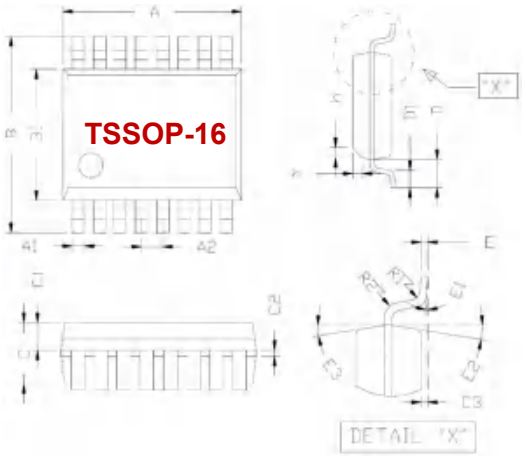
A.Load Capacitance CL = 150pF

B.The pulse generator has the following characteristics: transmission rate PRR=50 kbps, impedance Zo=50 Ω, duty cycle of 50%, rise time (tr) and fall time (tf) less than 10ns

Package information



Mark \ Size	Min(mm)	Max(mm)	Mark \ Size	Min(mm)	Max(mm)
A	9.80	10.00	C4	0.203	0.233
Al	0.356	0.456	D	1.05TYP	
A2	1.27TYP		D1	0.40	0.70
A3	0.302TYP		D2	0.15	0.25
B	3.85	3.95	R1	0.20TYP	
B1	5.84	6.24	R2	0.20TYP	
B2	5.00TYP		θ1	8°~ 12° TYP4	
C	1.40	1.60	θ2	8°~ 12° TYP4	
Cl	0.61	0.71	θ3	0°~ 8°	
Cp	0.54	0.64	θ4	4°~12°	
C3	0.05	0.25			



Symbol	Indicate	MIN	NOM	MAX
A	Overall length	4.95	5.00	5.05
A1	Foot width	0.20	0.22	0.24
A2	Foot spacing	0.60	0.65	0.70
B	Span	5.70	6.00	6.30
B1	Colloid width	3.80	3.90	4.00
C	Colloid thickness	0.95	1.00	1.05
C1	Thickness of upper collaid	0.40	0.41	0.42
C2		0.05	0.15	0.25
C3	Sand heght	0.02	0.08	0.10
D	Finge-sided Factory	0.85	1.05	1.25
D1	Foot length	0.40	0.65	0.85
E	Foot Thickness	0.15	0.20	0.25
E2	Foot Angle	0		8°
h		0.30	0.40	0.50

Model	Encapsulation	Package	Number
HX3232-S	SOP-16	Taping	2500
HX3232-ST	TSSOP-16	Taping	2500