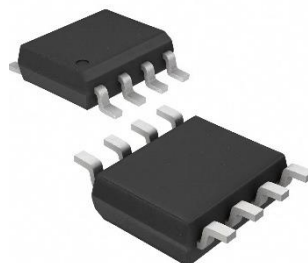


HX3172-S Bus Transceiver Circuit

The HX3172-S is an RS485/RS-422 transceiver circuit equipped with a 3.3V/5V voltage supply, half-duplex communication, and $\pm 15\text{KV}$ ESD protection. This circuit encompasses a driver and a receiver.

The HX3172-S showcases enhanced swing rate limits, which assist in minimizing output electromagnetic interference (EMI) and alleviating reflections caused by mismatched terminal connections, facilitating error-free data transfer rates of up to 500Mbps.

The receiver input impedance of the HX3172-S chip is 1/8 unit load, enabling the attachment of up to 256 transceivers for half-duplex communication on the bus. All driver outputs provide $\pm 15\text{KV}$ human mode ESD protection. The chip is packaged in SOP8 and is capable of operating within a temperature range from -40°C to $+125^\circ\text{C}$.



SOP-8

Peculiarity

- 3.3V/5V supply voltage
- Electrostatic protection (ESD) : $A/B \pm 15\text{KV}$, in line with the human body mode (HBM) standard
- With 1/8 unit load, the bus allows up to 256 transceivers to be attached
- Supports error-free data transmission up to 500Mbps
- With Fail-safe function
- Adopt SOP8 packaging.

Apply

- Industrial control
- ammeter
- Industrial motor drive
- Isolated RS485 interface
- Automated heating, ventilation and air conditioning (HVAC) systems

Chip Pin Description

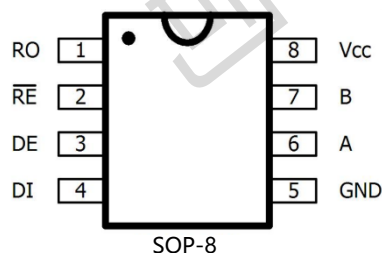
ID	NAME	FEATURE	INSTRUCTIONS
1	RO	Receiver data output	When the receiver is enabled, after polarity judgment, the following conditions apply: - If $V(A) - V(B) > -50\text{mV}$, then the RO output is high. - If $V(A) - V(B) < -200\text{mV}$, then the RO output is low. Here, A and B represent the in-phase terminals of the chip post-polarity judgment.
2	RE	Receiver output enable	When the receiver output is enabled, the RO output is effective if RE is connected to a low level; If RE is on a high level, the receiver will be turned off. At the same time, when RE is high and DE is low, the whole chip is turned off.
3	DE	Driver output enable	When DE is high, the driver output is enabled. When DE is low, the driver turns off and the output enters a high resistance state. Additionally, when RE is high and DE is low, the entire chip is in an off state.
4	DI	Drive driver data input	When the driver input DI is low level, the forced in-phase output is low level, and the reverse phase output is high level. When DI is high, the mandatory in-phase output is high, and the inverter output is low.
5	GND	Ground	Ground
6	A	Driver data output receiver data input	In the bus interface, the in-phase output of the driver is connected to the in-phase input of the receiver.
7	B	Driver data output receiver data input	In the bus interface, the inverting output of the driver is connected to the inverting input of the receiver.
8	Vcc	Power source	Power source

Drive truth table

Input			Exportation	
RE	DE	DI	B	A
X	1	1	0	1
X	1	0	1	0
0	0	X	Z	Z
1	0	X	Shutoff	

Receiver truth table

Input			Exportation
RE	DE	A-B	RO
0	X	$\geq -50\text{mV}$	1
0	X	$\leq -200\text{mV}$	0
0	X	Open/Short circuit	1
1	1	X	Z
1	0	X	Shutoff



SOP-8

DC electrical parameters							
limit Parameter							
SYMBOL	PARAMETR	MIN	MAX	UNIT			
VCC	supply voltage	3.0	+6.0	V			
DE, RE	Control input voltage	-0.3	+6.0	V			
DI	Drive input voltage	-0.3	+6.0	V			
A,B	Drv Out/Rcv In	-8.0	+13.0	V			
TSTG	Storage Temperature Range	-65	+150	°C			
TOP	Working temperature range	-40	+125	°C			
P _D	SOP-8 (+Above 70 °C)		471	mW			
T _L	Soldering temperature (10 seconds)		+300	°C			
DC characteristics (Vcc=+3.3V ± 5%, TA=25°C)							
PARAMETER		SYMBOL	Test conditions	MIN	TYP	MAX	UNIT
Driver							
Differential Drive Output (No Load)		VOD1	Figure 1	2			V
Differential drive output		VOD2	R=50Ω(RS-422) Figure 1	1.2			V
			R=27Ω(RS-485) Figure 1	1.2			V
Differential output amplitude variation		ΔVOD	R=50Ω or R=27Ω Figure1			0.2	V
Driver output common mode level		VOC	R=50Ω or R=27Ω Figure 1	0		3	V
Driver output common mode level variatio		ΔVOC	R=50Ω or R=27Ω Figure 1	-		0.2	V
Input High Level		VIH1	DE,DI, RE	2.0			V
Input low level		VIL1	DE,DI, RE			0.8	V
Input lag		VHYS	DE,DI, RE		100		mV
Input Current		IIN1	DE,DI, RE ²			±2	uA
Input current (A and B)		IIN4	DE=GND, VIN=12V			125	uA
			VCC=GNDor5.25V VIN=-7V	-75			
Driver output short-circuit current		IOD1	-7V≤VOUT≤VCC	-100			mA
			0V≤VOUT≤12V		100	mA	
			0V≤VOUT≤VCC	±25		mA	
Receiver							
Receiver differential input threshold voltage		VTH	-7V<VCM<+12V	-200	-	-50	mV
Receiver differential input threshold voltage hysteresis		ΔVTH		-	40	-	mV
Receiver output high level		VOH	IO=-4mA,VID=1V	Vcc-0.4	-	-0	V
Receiver output low level		VOL	IO=4mA,VID=-1V	0	-	.4±	V
"Receiver high impedance leakage current"		IOZR	0.4V≤VO≤2.4V	-	-	1±	uA
Receiver input impedance		RIN	-7V≤VCM≤+12V	96	-		KΩ
Receiver output short-circuit current		IOSR	0V≤VRO≤VCC	±7	-	956	mA
Power supply currentDE=VCC							
Static power supply current		ICC	No load, RE=DI=GNDorVcc	DE=GND	450	006	uA
turn-off current		SHDN	DE=GND, RE=Vcc	0.1		10	uA
Static protection characteristics							
Electrostatic protection (Pin A, Pin B)			Contact discharge model	±12			KV
			manikin	±15			
Electrostatic protection			manikin	±4			KV
Communication characteristics (Vcc=3.3V ± 5%, TA=25 °C)							
PARAMETER		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Driver input/output delay		tDPLH	RDIFF=54Ω,	25	72	10	ns
		tDPHL	CL=54pF Figure 3, 5	25	72	10	
Difference in Input and Output Delay of Drivers		tDSKEW	RDIFF=54ΩCL1=CL2=100pFigure 3, 5	-3	±1		ns
Drive up and down time		tDR,tDF	RDIFF=54ΩCL1=CL2=100pFigure 3, 5	40	70	12	ns
maximum rate		fMAX	CL=100pF,S2 Turn off Figure4,6	-	50		kb
Enable the driver to output at a high level		tDZH	CL=100pF,S1 Turn off Figure4,6			25	ns
Enable the driver to output at a low level		tDZL	CL=15pF,S1 Turn off Figure4,6			25	ns
Drive from low output to shutdown time		tDLZ	CL=15pF,S2 Turn off Figure4,6			500	ns
Drive from high output to shutdown time		tDHZ				500	ns
Receiver input/output delay		tRPLH	VID ≥2.0V ; The VID's rise and fall time, as depictedn Figures 7 , 9, is under 15ns.		125	250	ns
		tRPHL					
TRPLH tRPHL Receiver Input Output Delay Difference		tRSKD		10	±50		ns
Receiver enabled to output low		tRZL	CL=100pF,S1 Turn off Figure2,8	20	120		ns
Receiver enables high output		tRZH	CL=100pF,S2 Turn off Figure2,8	20	120		ns
Receiver switches from high output to off		tRHZ	CL=100pF,S1 Turn off Figure2,8	20	120		ns
Receiver switches from low output to off		tRLZ	CL=100pF,S2 Turn off Figure2,8	20	120		ns
Chip shutdown time		tSHDN		50	200	600	ns
From chip off to driver enabled to output high		tDZH(SH DN)	CL=15pF,S2 Turn off Figure4,6			4500	ns
From chip off to driver enabled to output low		TdZl(SH DN)	CL=15pF,S1 Turn off Figure4,6			4500	ns
From chip off to driver enabled to output high		tRZH(SH DN)	CL=100pF,S2 Turn off Figure2,8			3500	ns
From chip off to driver enabled to output low		tRZL(SH DN)	CL=100pF,S1 Turn off Figure2,8			3500	ns

Notes: 1 Δ VOD and Δ VOC respectively represent the changes in VOD and VOC when DI changes.

2 The current is positive when flowing in and negative when flowing out. Unless noted, all voltages are referenced to ground.

3 WhenR_{OD}=1 and DE=0 , SN3485 enters the OFF state. If the duration of the off state is less than 50ns, the chip will not enter the off state. If the duration of the off state exceeds 600ns, the chip must enter the off state.

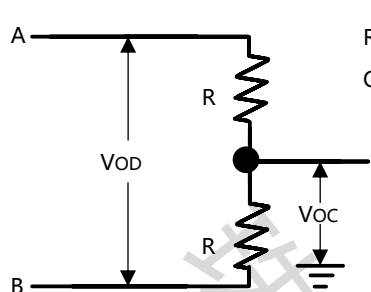


Figure 1 Driver DC characteristic test load

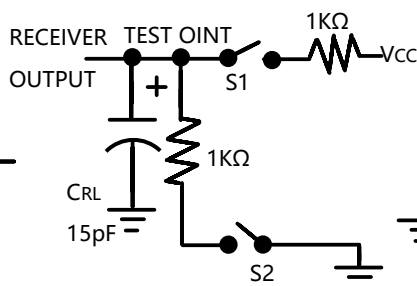


Figure 2 Receiver enable/Off switch characteristic test load

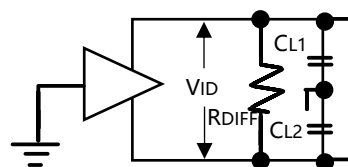


Figure 3. Actuator switch characteristic test circuit

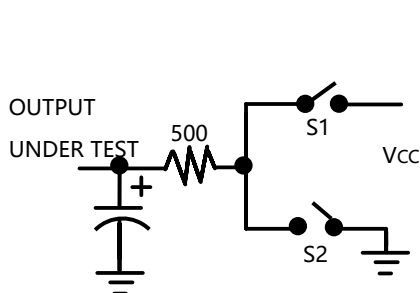


Figure 4 Driver enable/Off switch characteristic test load

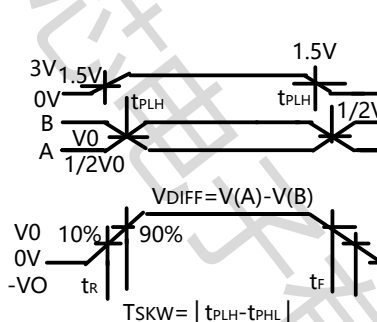


Figure 5 Driver transmission delay

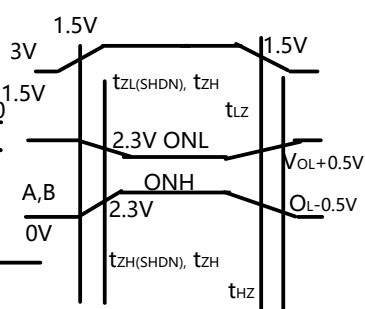


Figure 6 Drive enable/disable sequence

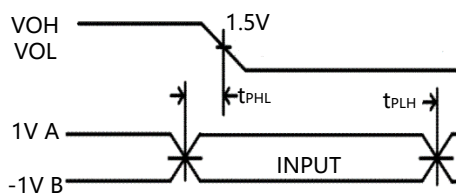


Figure 7 Receiver transmission delay

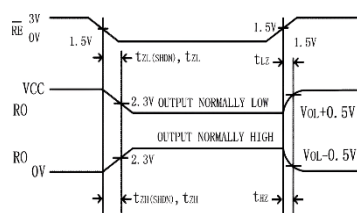


Figure 8 Receiver on/Off sequence

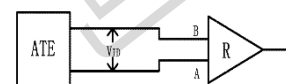


Figure 9 Receiver transmission delay test electrical

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Function Description

Bus Loading

The HX3172-S chip supports up to 256 transceivers on the same bus. A standard RS-485 receiver has an input impedance of $12\text{K}\Omega$ (1 unit load), while the HX3172-S features an input impedance of $96\text{K}\Omega$ (1/8 unit load). This allows for a total of 256 transceivers on the same bus. These devices can be used in any combination, including with other RS-485 transceivers, as long as the total load does not exceed 32 unit loads on the same bus.

Low power off mode

When RE is at high level and DE is at low level, the chip enters low-power shutdown mode. The typical value of turn off current is $1.8\mu\text{A}$. RE and DE can be driven simultaneously. If RE is at a high level and DE is at a low level for less than 50ns, the chip will not enter shutdown mode; If the holding time exceeds 600ns, the chip will ensure to enter the shutdown mode.

Reduce EMI and reflection

The limited swing rate driver of HX3172-S can reduce electromagnetic interference (EMI) and minimize reflections caused by improper terminal matching cables, achieving error free data transmission of up to 15Mbps.

Driver output protection

HX3172-S includes overcurrent and overpower protection mechanisms. The overcurrent protection circuit activates when excessive current occurs due to bus abnormalities, preventing the driving current from exceeding a preset limit. Additionally, the overtemperature protection circuit safeguards the chip by ensuring it remains undamaged during high power consumption and rising temperatures. If activated, this mode transitions the driver output to a high-resistance state.

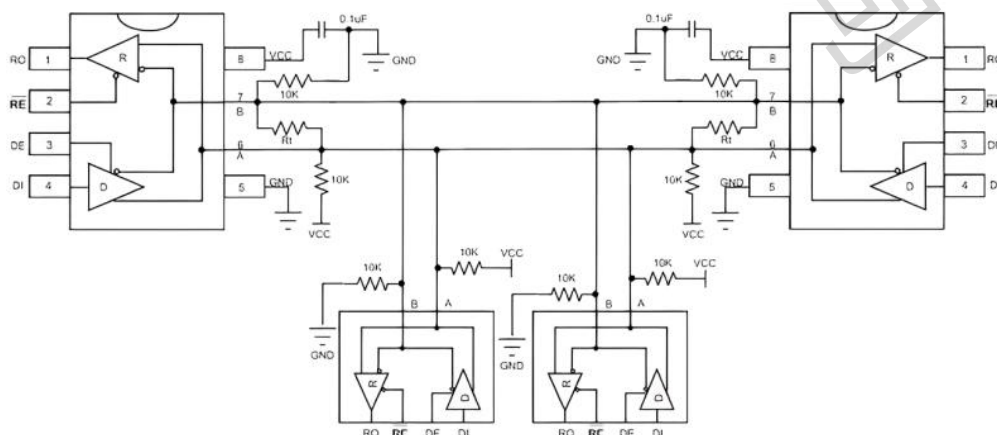
Typical applications

The HX3172-S is often used in multipoint networks for two-way communication. To minimize reflection, it's crucial to match its characteristic impedance at both ends of the transmission line, and keep the branch line length outside the main trunk as short as possible.

Electrostatic protection

The HX3172-S features ESD protection circuits on all pins to prevent damage during manual handling or assembly. Its driver and receiver pins have enhanced ESD circuits that can endure $\pm 15\text{kV}$ human-mode ESD shocks without harm. These circuits are inactive during normal operation, avoiding current consumption. Post ESD, the chip operates flawlessly without latch-up or damage. Testing includes $\pm 15\text{kV}$ human body model and $\pm 12\text{kV}$ IEC61000-4-2 contact discharge methods.

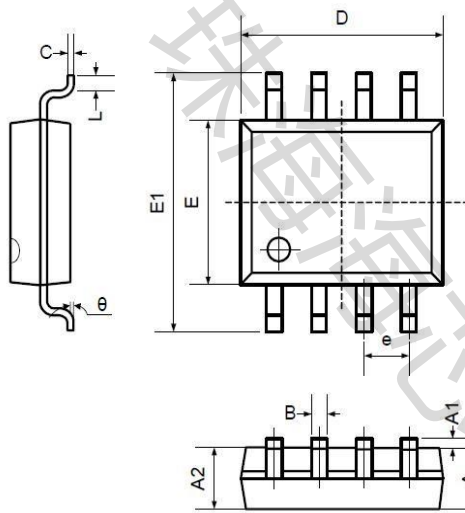
Typical Application Diagram



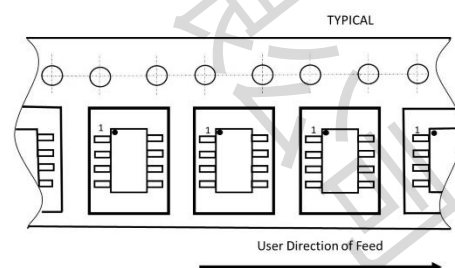
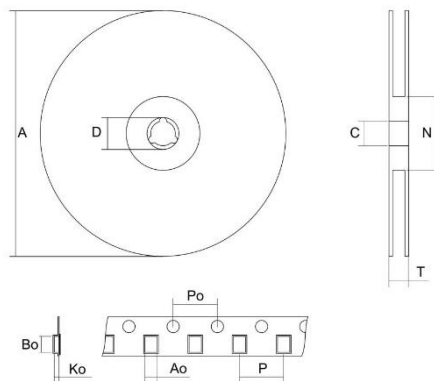
Rt is the feature matching impedance with a typical value of 120Ω

Packaging and packaging

SOP8 (Package Outline Dimensions)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°



Packaging method	Number
Braid	2500PCS/disk