3.3V power supply,up to 256 nodes,12Mbps,half-duplex RS485/RS422 transceiver

Features:

- 3.3V power supply, half-duplex;
- 1/8 unit load allows up to 256 devices on the bus;
- Driver output short-circuit protection;
- Over temperature protection function;
- Low power shutdown function;
- Receiver open circuit protection;
- Strong anti-noise ability;
- Integrated transient voltage resistance function;
- Transmission rate up to 12Mbps in an electrical noise environment;

Description:

The SP3485 is a 3.3V powered, half-duplex, low-power RS-485 transceiver that fully meets the requirements of the TIA/EIA-485 standard.

The SP3485 includes a driver and a receiver, both of which can be independently enabled and disabled. When both are disabled, both the driver and the receiver output a high impedance state. The SP3485 has a 1/8 load that allows 256 SP3485 tranceivers to be connected to the same communication bus. Error-free data transfer of up to 12Mbps is possible.

The SP3485 operates from a voltage range of 3.0 to 3.6V and features fail-safe, over temperature protection, current limit protecton, overvoltage protection, and other functions.

Pin configuration:

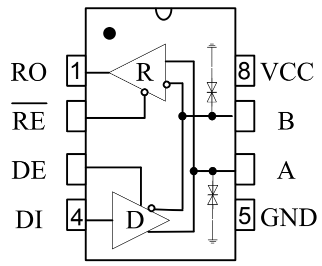


Fig. 1 SP3485 pin configuration

Limiting values:

Parameter	Symbol	Value	Unit
Supply voltage	VCC	+7	V
Voltage of control port	/RE, DE, DI	-0.3~+7	V
Bus side input voltage	A, B	-7~13	V
Receiver output voltage	RO	-0.3~+7	V
Operating temperature range		-40~85	°C
Storage temperature range		-60~150	°C
Welding temperature		300	°C
Continuous power disspation	SOP8	400	mW
	MSOP8/8μMAX/VSSOP8	830	mW
	DIP8	700	mW

The maximum limit parameters means that exceeding these values may cause irreversible damage to the device. Under these conditions it is not conductive to the normal operation of the device. The continuous operation of the device at the maximum allowable rating may affect the reliability of the device. The reference point for all voltages is ground.

Pin functions:

Pin number	Pin name	Function
1	RO	Receiver output When /RE is low-level: if A-B ≧ 200mV, RO = high; if A-B ≦ -200mV, RO = low
2	/RE	Receiver output enable control When /RE is low-level, receiver output is enabled, and RO output is available. When /RE is high-level, receiver output is disabled, and RO is in high impedance state. When /RE is high-level and DE is low-level, the device enters low power consumption mode.
3	DE	Driver output enable control When DE is high-level, driver output is available; when DE is low-level, the output is in high impedance state. When /RE is high-level and DE is low-level, the device enters low power consumption mode.
4	DI	Driver input When DE is high level, the DI low level forces the non-inverting driver output A low and inverting driver output B high; The DI high level forces the non-inverting driver output A high and inverting driver output B low.
5	GND	Ground
6	A	Non-inverting receiver input and non-inverting driver output
7	B	Inverting receiver input and inverting driver output
8	VCC	Power supply

Driver electrical characteristics

Parameter	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Differential output voltage (no load)	V_{OD1}			3.3		V
Diferential output voltage	V_{OD2}	Fig. 2, RL = 54Ω	1.5		VCC	V
		Fig. 2, RL = 100Ω	2		VCC	
Change in magnitude of differential output voltage (NOTE1)	ΔV_{OD}	Fig. 2, RL = 54Ω			0.2	V
Common mode output voltage	V_{OC}	Fig. 2, RL = 54Ω			3	V
Change in magnitude of common mode output voltage (NOTE1)	ΔV_{OC}	Fig. 2, RL = 54Ω			0.2	V
Input high voltage	V_{IH}	DE, DI, /RE	2.0			V
Input low voltage	V_{IL}	DE, DI, /RE			0.8	V
Logic input current	I_{IN1}	DE, DI, /RE	-2		2	uA
Output short-circuit current, short-circuit to high	I_{OSD1}	short-circuit to 0V~12V			250	mA
Output short-circuit current, short-circuit to low	I_{OSD2}	short-circuit to -7V~0V	-250			mA
Thermal shutdown threshold				140		°C
Thermal shutdown hysteresis				20		°C

(unless otherwise stated VCC=3.3V±10%, Temp=TMIN~TMAX, typical value is VCC=+3.3V, Temp＝25°C)

NOTE1: ΔV_{OD} and ΔV_{OC} are the changes in V_{OD} and V_{OC} amplitute caused by a change of DI state of the input signal.

Receiver electrical characteristics

Parameter	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Input current (A, B)	I_{IN2}	DE=0V, VCC=0 or 3.3V VIN=12V			125	uA
		DE=0V, VCC=0 or 3.3V VIN=-7V	-100			uA

Positive-going input threshold voltage	V_{IT+}	-7V≦V_{CM}≦12V			+200	mV
Negative-going input threshold voltage	V_{IT-}	-7V≦V_{CM}≦12V	-200			mV
Hysteresis voltage	V_{hys}	-7V≦V_{CM}≦12V	10	30		mV
High-level output voltage	V_{OH}	I_{OUT}= −2.5mA, V_{ID}= +200 mV	VCC-1.5			V
Low-level output voltage	V_{OL}	I_{OUT}= +2.5mA, V_{ID}= -200 mV			0.4	V
Tristate leakage current	I_{OZR}	0.4V < V_O< 2.4V			±1	uA
Receiver input resistance	R_{IN}	-7V≦V_{CM}≦12V	96			kΩ
Receiver short-circuit current	I_{OSR}	0V ≤ V_O≤ VCC	±8		±60	mA

(unless otherwise stated VCC=3.3V±10%, Temp=TMIN~TMAX, typical value is VCC=+3.3V, Temp＝25°C)

Supply current

Parameter	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Supply current	I_{CC1}	/RE=0V, DE = 0 V		520	800	uA
	I_{CC2}	/RE=VCC, DE=VCC		540	700	uA
Shutdown current	I_{SHDN}	/RE=VCC, DE=0V		0.5	10	uA

Driver switching characteristics

Parameter	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Driver differential output delay	t_{DD}	R_{DIFF} = 60Ω, C_{L1}=C_{L2}=100pF (see fig. 3, 4)		10	35	ns
Driver differential output transition time	t_{TD}			12	25	ns
Driver propagation delay, low-to-high	t_{PLH}	R_{DIFF} = 27Ω, (see fig. 3, 4)		8	35	ns
Driver propagation delay, high-to-low	t_{PHL}			8	35	ns

$\lvert t_{PLH}-t_{PHL} \rvert$	t_{PDS}			1	8	ns
Driver enable to output high	t_{PZH}	R_L= 110Ω, (see fig. 5, 6)		20	90	ns
Driver enable to output low	t_{PZL}			20	90	ns
Driver disable time from low	t_{PLZ}	R_L= 110Ω, (see fig. 5, 6)		20	80	ns
Driver disable time from high	t_{PHZ}			20	80	ns
Driver enable from shutdown to output high	t_{DSH}	R_L= 110Ω, (see fig. 5, 6)		500	900	ns
Driver enable from shutdown to output low	t_{DSL}	R_L= 110Ω, (see fig. 5, 6)		500	900	ns

Receiver switching characteristics

Parameter	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Receiver input to output delay (low to high)	t_{RPLH}	C_L=15pF (see fig. 7, 8)		80	150	ns
Receiver input to output delay (high to low)	t_{RPHL}			80	150	ns
$\lvert t_{RPLH}- t_{RPHL} \rvert$	t_{RPDS}			7	10	ns
Receiver enable to output low	t_{RPZL}	C_L=15pF (see fig. 7, 8)		20	50	ns
Receiver enable to output high	t_{RPZH}	C_L=15pF (see fig. 7, 8)		20	50	ns
Receiver disable time from low	t_{PRLZ}	C_L=15pF (see fig. 7, 8)		20	45	ns
Receiver disable time from high	t_{PRHZ}	C_L=15pF (see fig. 7, 8)		20	45	ns
Receiver enable from shutdown to output high	t_{RPSH}	C_L=15pF (see fig. 7, 8)		200	1400	ns
Receiver enable from shutdown to output low	t_{RPSL}	C_L=15pF (see fig. 7, 8)		200	1400	ns
Time to shutdown	t_{SHDN}	NOTE2	80		300	ns

NOTE2: The device is put into shutdown by bringing RE high and DE low. If the enable inputs are in this state for less than 80ns, the device is guaranteed not to enter shutdown. If the enable inputs are in this state for at least 300ns, the device is guaranteed to have entered shutdown.

Function table

Driver

Control		Input	Output	
/RE	DE	DI	A	B
X	1	1	H	L
X	1	0	L	H
0	0	X	Z	Z
1	0	X	Z(shutdown)	
X: don' t care； Z: high impedance				

Receiver

Control		Input	Output
/RE	DE	A-B	RO
0	X	⩾200mV	H
0	X	⩽-200mV	L
0	X	Open/short-circuit	H
1	X	X	Z
X: don' t care； Z: high impedance			

Test circuit

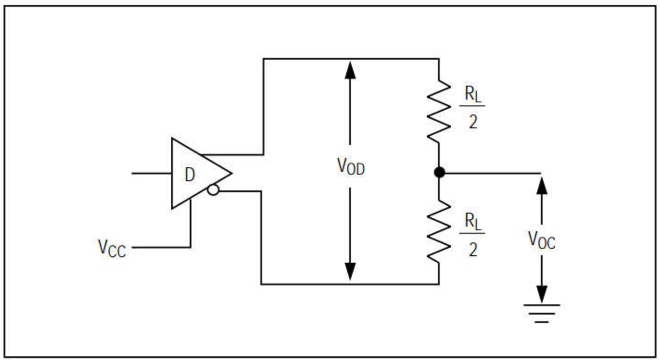
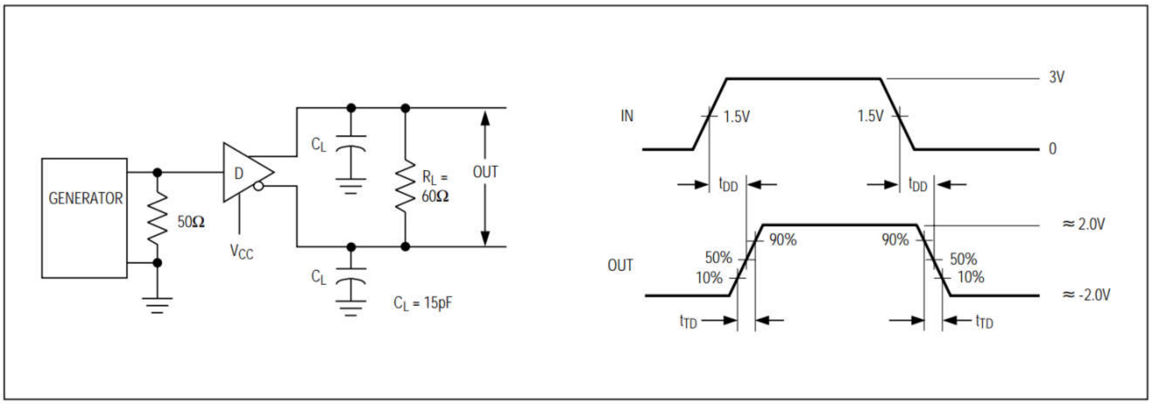


Fig. 2 Driver DC test load



C_L includes probe and stray capacitance (same as below)

Fig. 3 Driver differential output delay and transition times

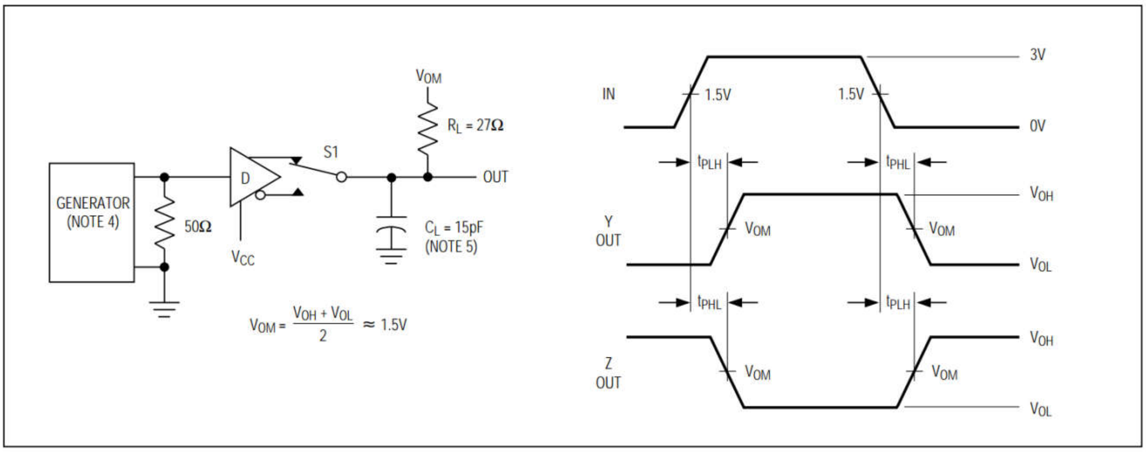


Fig. 4 Driver propagation times

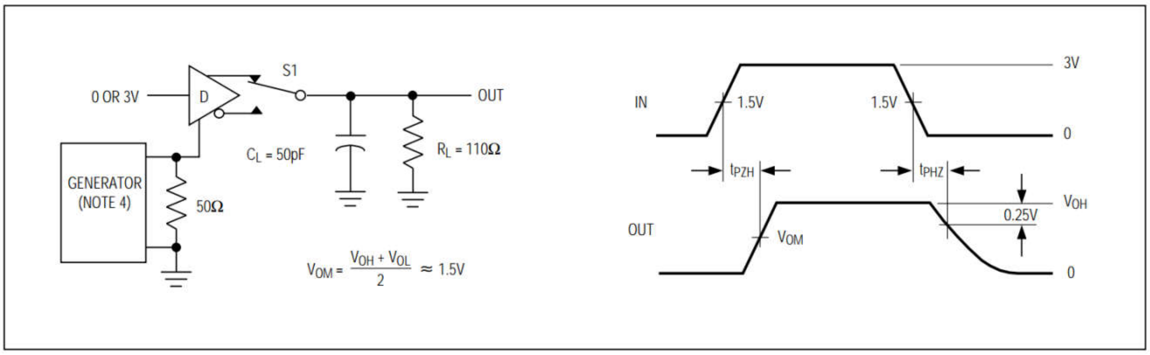


Fig. 5 Driver enable and disable times

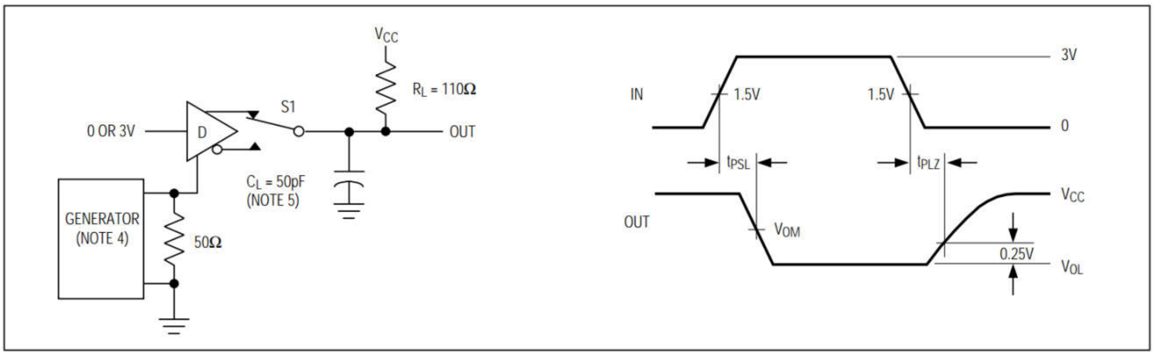


Fig. 6 Driver enable and disable times

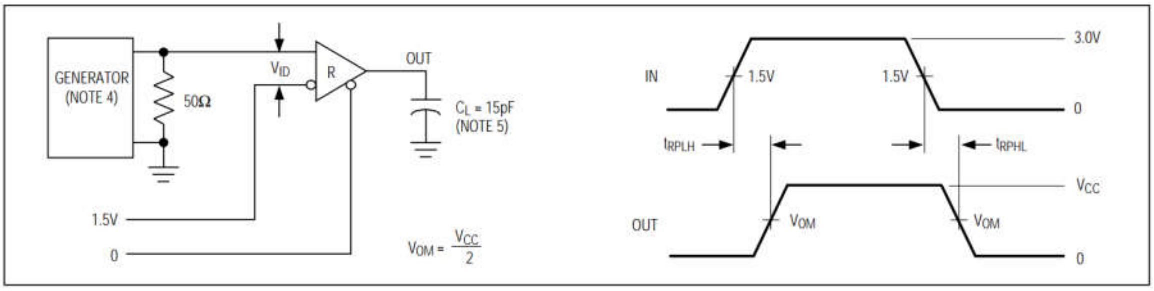


Fig. 7 Receiver propagation delay

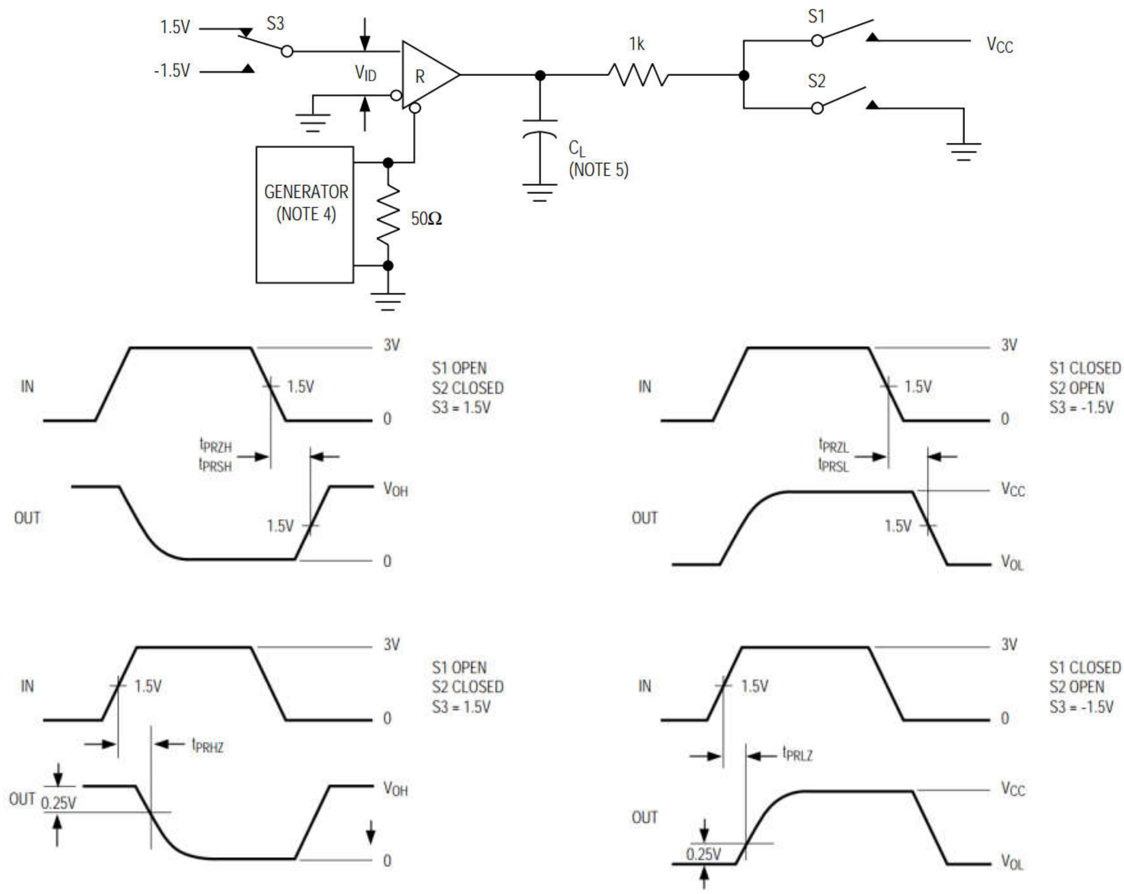


Fig. 8 Receiver enable and disable times

General description

1 Brief description

The SP3485 is a full-duplex high-speed trasceiver for RS-485/RS-422 communication, and includes one driver and one receiver. It has fail-safe, over-voltage protection and over-current protection. The SP3485 allows error-free data transmission up to 12Mbps.

2 Allowing up to 256 transceivers on the bus

The standard RS-485 receiver has an input impedance of 12kΩ (1 unit load), and the standard driver can drive up to 32 unit loads. The receiver of the SP3485 transceiver has a 1/8 unit load receiver input impedance (96kΩ), allowing up to 256 transceivers to be connected in parallel on one bus. These devices can be combined arbitrarily, or combined with other RS-485 transceivers, as long as the total load does not exceed 32 units.

3 Driver output protection

Two mechanisms are used to avoid faults or bus collisions that cause excessive output current and excessive power consumption. First, over-current protection provides fast short-circuit protection over the entire common-mode voltage range (refer to the typical operating characteristics). Second, the thermal shutdown circuit forces the driver output into a high-impedance state when the die temperature exceeds 140° C.

4 Typical applications

4.1 Bus networking: The SP3485 RS485 transceiver is designed for bidirectional data communication on multi-point bus transmission lines. Figure 9 shows a typical network application circuit. These devices can also be used as linear repeaters with cables longer than 4000 feet. In order to reduce reflections, terminal matching should be done at both ends of the transmission line with their characteristic impedance, and the length of the branch wires other than the main line should be as short as possible.

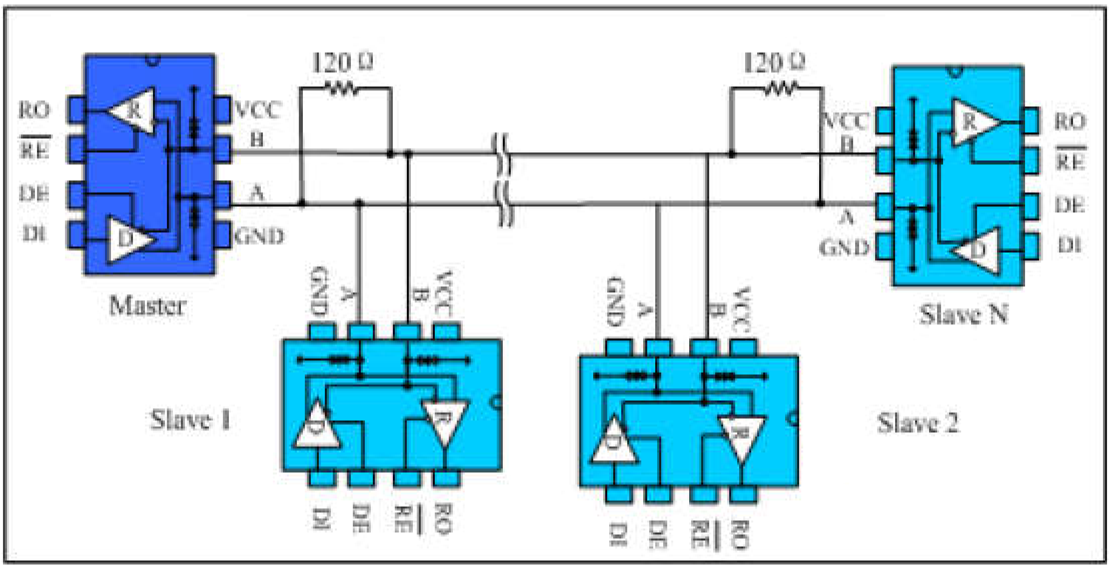


Fig.9 Bus-type RS485 half-duplex communication network

4.2 Hand-in-hand networking: Also known as daisy chain topology, it is the standard and specification of RS485 bus wiring, and is the recommended RS485 bus topology for organizations such as TIA. The wiring mode is that the master device and multiple slave devices form a hand-in-hand connection with no branch left, as shown in Figure 10. This wiring method has the advantages of small signal reflection and high communication success rate.

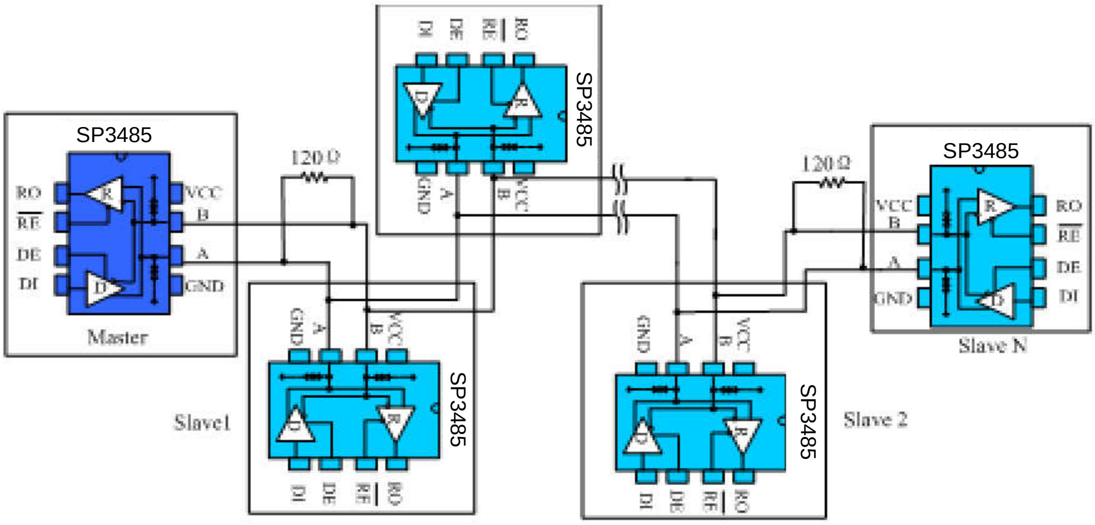


Fig. 10 Hand-in-hand type RS485 half-duplex communication network

4.3 Bus port protection: In harsh environments, RS485 communication ports are usually protected against static electricity, lightning and surge protection, etc. and it is even necessary to prevent 380V power supply access to avoid damage of smart meters and industrial control hosts. Figure 11 shows 3 common kinds of RS485 bus port protection schemes.

The first scheme is to connect the TVS device to the protection ground in parallel with the AB port, the TVS device in parrallel with the AB port, the thermistor in series with the AB port and the gas discharge tube is connected to the protection ground to form a three-level protection scheme.

The second scheme is a three-level protection scheme including TVS connected to the ground in parallel with AB, the thermistor in series and the varistor in parallel with AB.

The third one includes pull-down resistors connected to the power supply and ground respectively for AB, TVS between AB and the thermistor connected to A or B port.

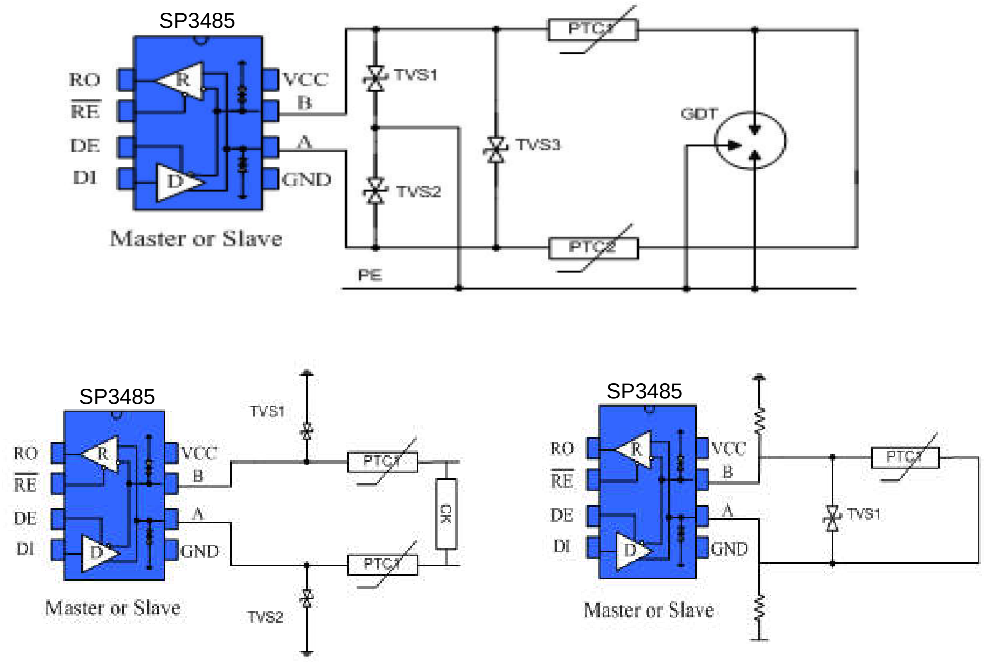


Fig. 11 Bus port protection scheme