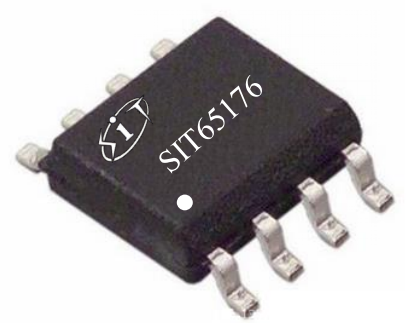
FEATURES

- 5V±10% power supply, half-duplex;
- Bus port ESD level 15kV HBM;
- Bus fault tolerance withstand voltage up to ±15V;
- 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 10Mbps in an electrical noise environment;

OUTLINE



Provide green and environmentally friendly lead-free package

DESCRIPTION

The SIT65176B is a 5V±10% powered, 15kV ESD protected, half-duplex, low-power RS-485 transceiver with a bus withstand voltage range up to ±15V. It fully meets the requirements of the TIA/EIA-485 standard.

The SIT65176B 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 SIT65176B has a 1/8 load that allows 256 SIT65176B tranceivers to be connected to the same communication bus. Error-free data transfer of up to 10Mbps is possible.

The SIT65176B operates from a voltage range of 4.5 to 5.5V and features fail-safe, over-temperature protection, current limit protection, over-voltage protection, and other functions.

PIN CONFIGURATION

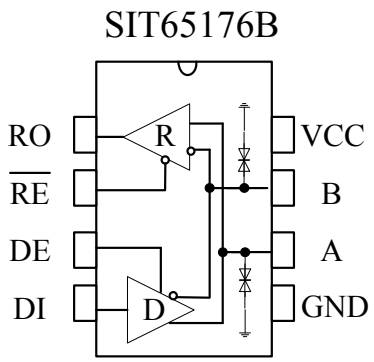


Figure 1 SIT65176B pin configuration

LIMITING VALUES

Parameter	Symbol	Value	Unit
Supply voltage	VCC	+7	V
Voltage of control port	/RE, DE, DI	-0.3~VCC+0.5	V
Bus side input voltage	A, B	-15~+15	V
Receiver output voltage	RO	-0.3~VCC+0.5	V
Operating temperature range		-40~85	°C
Storage temperature range		-60~150	°C
Welding temperature		300	°C
Continuous power dissipation	SOP8	470	mW
	MSOP8	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}		2.5		5.5	V
Diferential output voltage	V_{OD2}	Fig. 2, RL = 54Ω		3.5	VCC	V
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 Temp=T_{MIN}~T_{MAX}, Temp=25°C, VCC=5V)

NOTE1: ΔV_{OD} and ΔV_{OC} are the changes in V_{OD} and V_{OC} amplitude 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 5V V_{IN} = 12V			125	uA
		DE = 0V, VCC=0 or 5V V_{IN} = -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 Temp=T_{MIN}~T_{MAX}, Temp=25°C, VCC=5V)

SUPPLY CURRENT

Parameter	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Supply current	I_{CC1}	/RE = 0V, DE = 0V		470	750	uA
	I_{CC2}	/RE = 0V, DE = 0V		510	750	uA
Shutdown current	I_{SHDN}	/RE = VCC, DE = 0V		0.1	10	uA

(unless otherwise stated Temp=T_{MIN}~T_{MAX}, Temp=25°C, VCC=5V)

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)		12	32	ns
Driver differential output transition time	t_{TD}			15	28	ns
Driver propagation delay, low-to-high	t_{PLH}	R_{DIFF} = 27Ω, (see fig. 3, 4)	18		40	ns
Driver propagation delay, high-to-low	t_{PHL}		18		40	ns
$\|t_{PLH}-t_{PHL}\|$	t_{PDS}			1	2.5	ns
Driver enable to output high	t_{PZH}	R_L = 110Ω, (see fig. 5, 6)			55	ns
Driver enable to output low	t_{PZL}				55	ns
Driver disable time from low	t_{PLZ}	R_L = 110Ω, (see fig. 5, 6)			85	ns
Driver disable time from high	t_{PHZ}				85	ns
Driver enable from shutdown to output high	t_{DSH}	R_L = 110Ω, (see fig. 5, 6)		400	1000	ns
Driver enable from shutdown to output low	t_{DSL}	R_L = 110Ω, (see fig. 5, 6)		400	1000	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)		70		ns
Receiver input to output delay (high to low)	t_{RPHL}			70		ns
$\|t_{RPLH}- t_{RPHL}\|$	t_{RPDS}			5		ns
Receiver enable to output low	t_{RPZL}	C_L = 15pF (see fig. 7, 8)		15		ns
Receiver enable to output high	t_{RPZH}	C_L = 15pF (see fig. 7, 8)		15		ns
Receiver disable time from low	t_{PRLZ}	C_L=15pF (see fig. 7, 8)		25	55	ns

Receiver disable time from high	t_{PRHZ}	C_L=15pF (see fig. 7, 8)		25	55	ns
Receiver enable from shutdown to output high	t_{RPSH}	C_L=15pF (see fig. 7, 8)		250	1500	ns
Receiver enable from shutdown to output low	t_{RPSL}	C_L=15pF (see fig. 7, 8)		250	1500	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

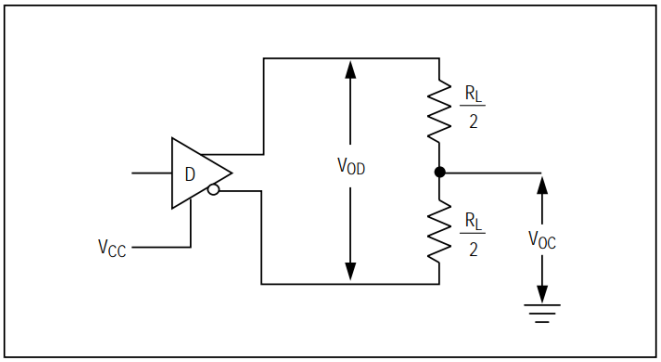
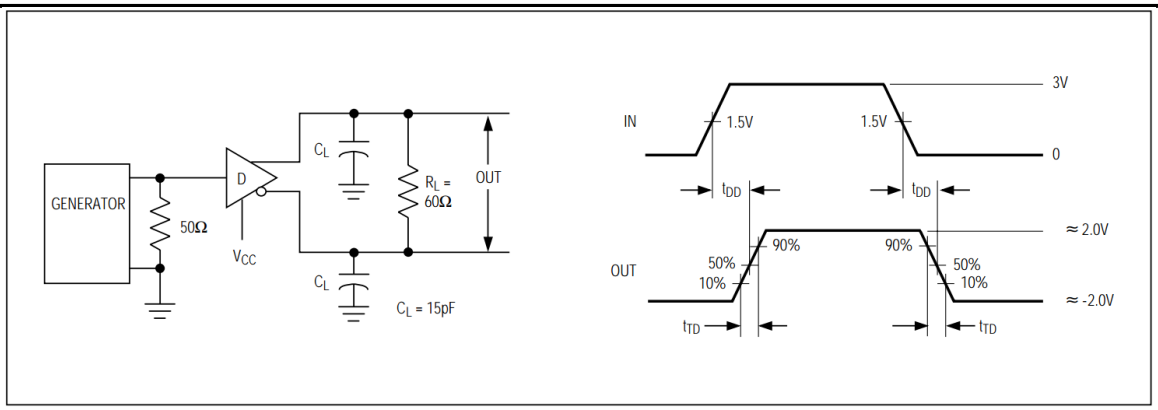


Fig. 2 Driver DC test load



C_L includes probe and stray capacitance (same as below)

Fig. 3 Driver differential output delay and transition times

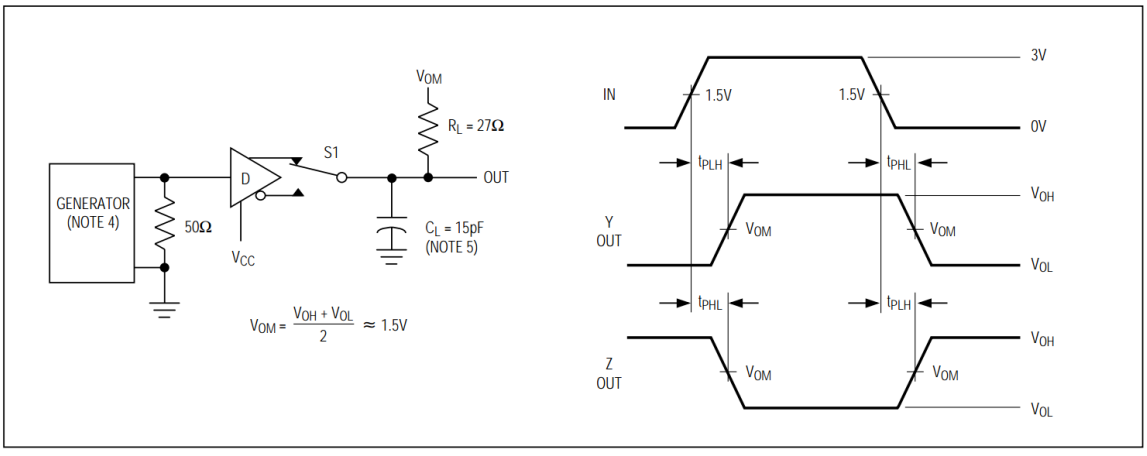


Fig. 4 Driver propagation times

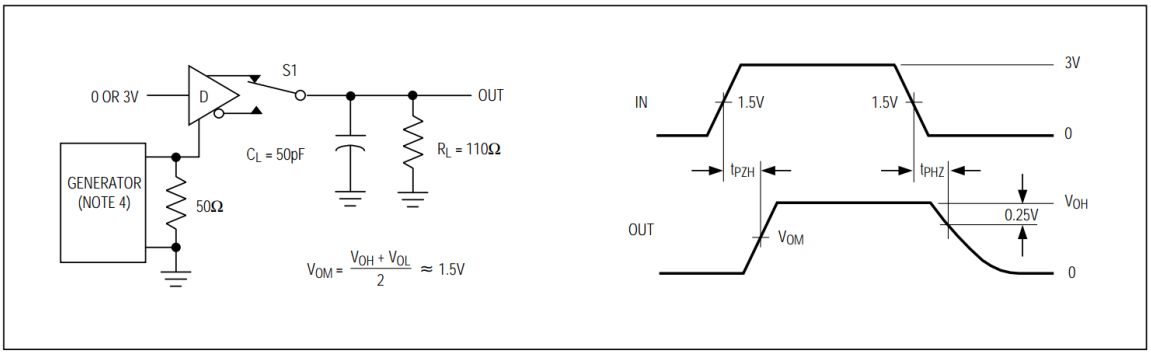


Fig. 5 Driver enable and disable times

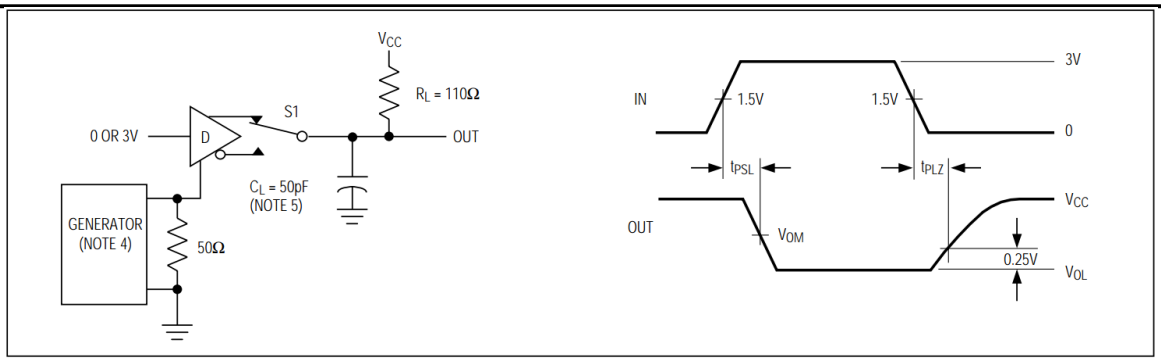


Fig. 6 Driver enable and disable times

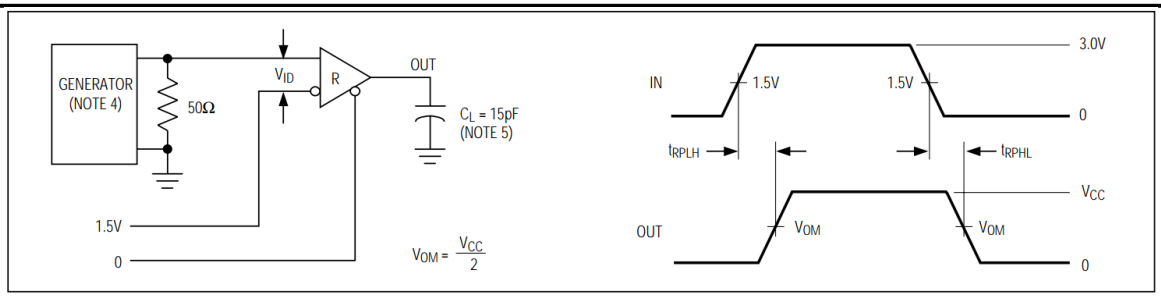


Fig. 7 Receiver propagation delay

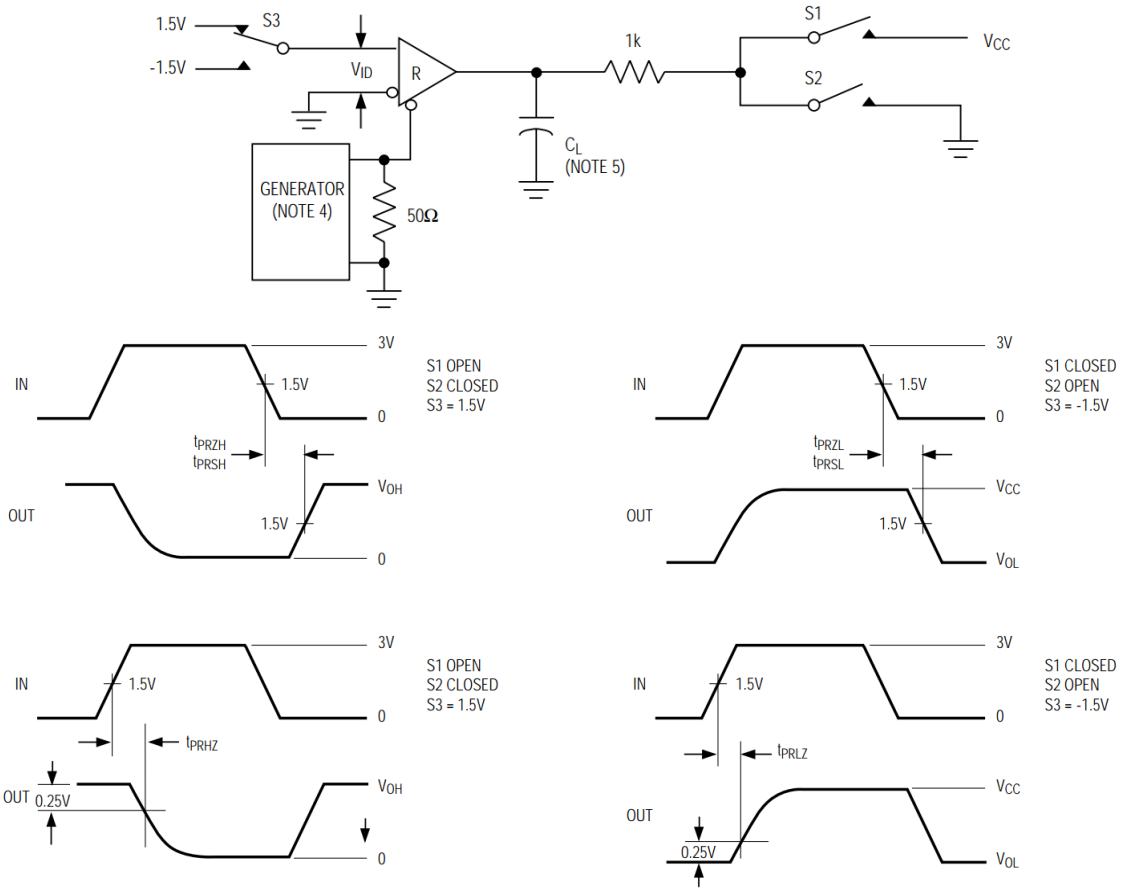


Fig. 8 Receiver enable and disable times

GENERAL DESCRIPTION

1 Brief description

The SIT65176B is a 4.5~5.5V powered, 15kV ESD protected, half-duplex transceiver for RS-485/RS-422 communication with a bus withstand voltage range up to ±15V. It includes one driver and one receiver and has fail-safe, over-voltage protection, over-current protection and over-temperature protection. The SIT65176B allows error-free data transmission up to 10Mbps.

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 SIT65176B 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 SIT65176B 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.

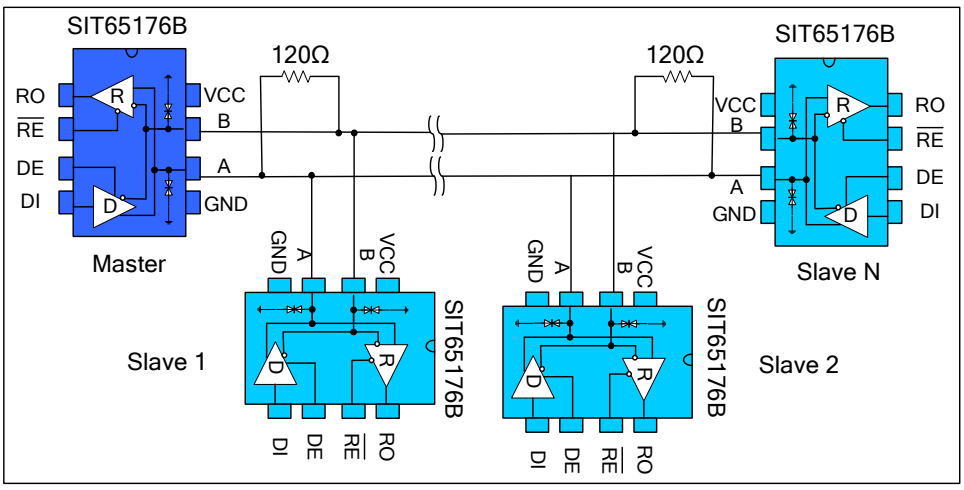


Fig. 9 Bus-type RS485 half-duplex communication network

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.

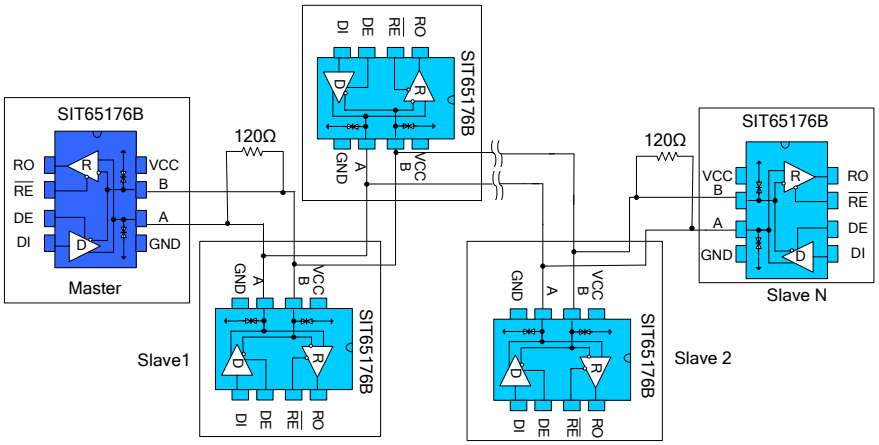


Fig. 10 Hand-in-hand type RS485 half-duplex communication network

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.

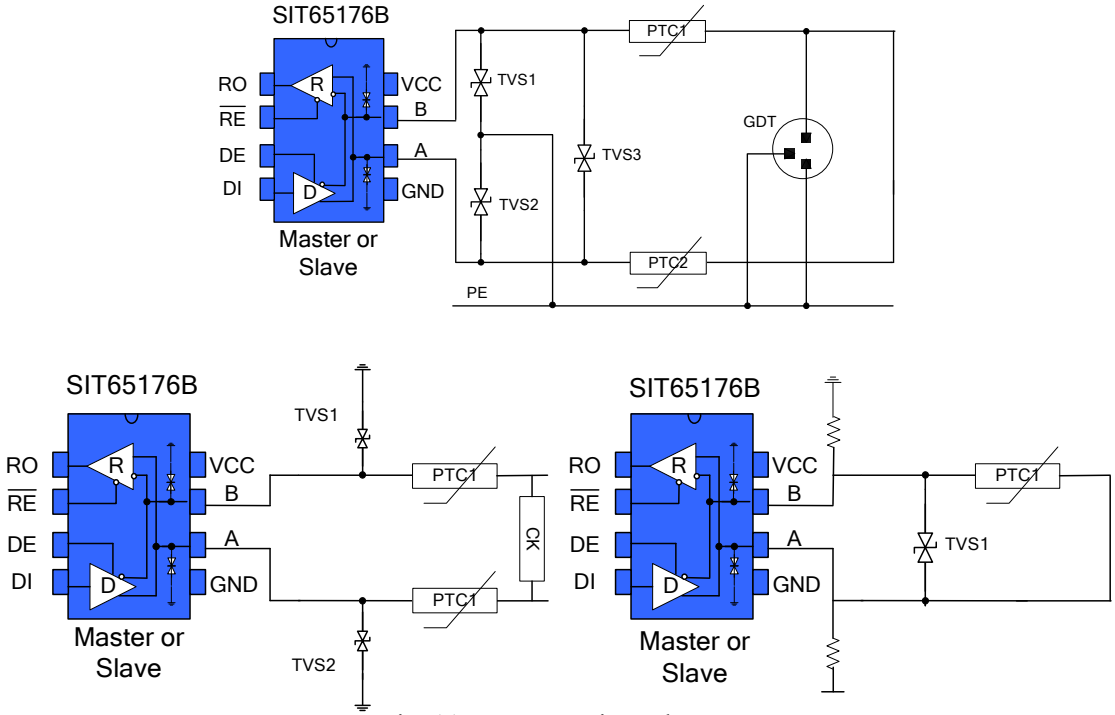
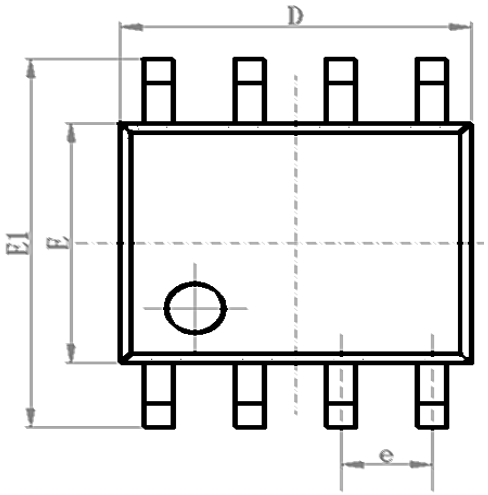


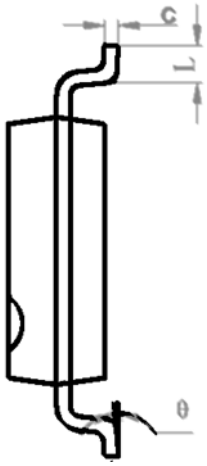
Fig. 11 Port protection scheme

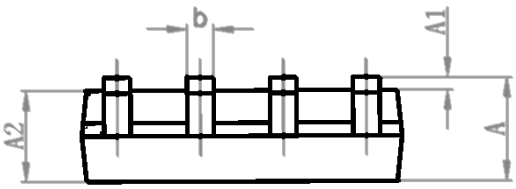
SOP8 DIMENSIONS

PACKAGE SIZE

SYMBOL	MIN./mm	TYP./mm	MAX./mm
A	1.50	1.60	1.70
A1	0.1	0.15	0.2
A2	1.35	1.45	1.55
b	0.355	0.400	0.455
D	4.800	4.900	5.00
E	3.780	3.880	3.980
E1	5.800	6.000	6.200
e		1.270BSC	
L	0.40	0.60	0.80
c	0.153	0.203	0.253
θ	-2°	-4°	-6°



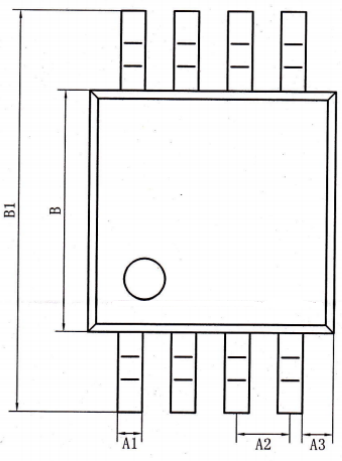


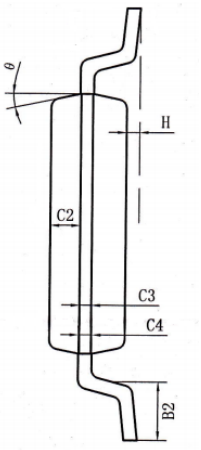


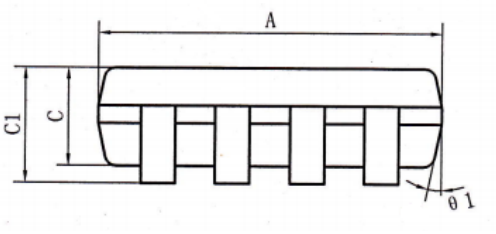
MSOP8 / 8μMAX / VSSOP8 DIMENSIONS

PACKAGE SIZE

SYMBOL	MIN./mm	TYP./mm	MAX./mm
A	2.90	3.0	3.10
A1	0.28		0.35
A2	0.65TYP		
A3	0.375TYP		
B	2.90	3.0	3.10
B1	4.70		5.10
B2	0.45		0.75
C	0.75		0.95
C1			1.10
C2	0.328 TYP		
C3	0.152		
C4	0.15		0.23
H	0.00		0.09
θ	12°TYP		



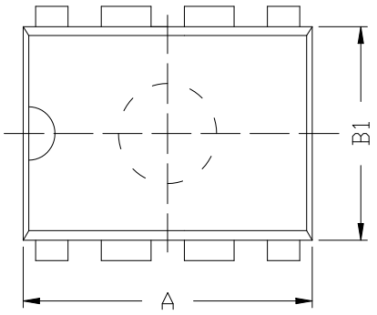


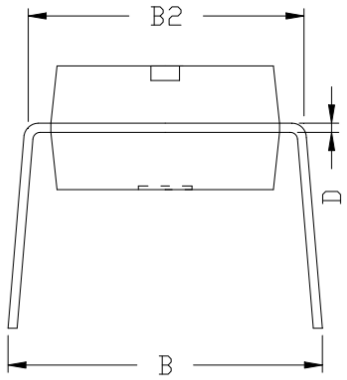


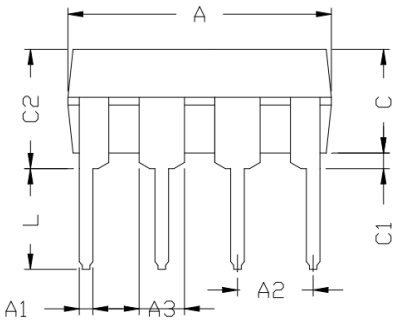
DIP8 DIMENSIONS

PACKAGE SIZE

SYMBOL	MIN./mm	TYP./mm	MAX./mm
A	9.00	9.20	9.40
A1	0.33	0.45	0.51
A2		2.54TYP	
A3		1.525TYP	
B	8.40	8.70	9.10
B1	6.20	6.40	6.60
B2	7.32	7.62	7.92
C	3.20	3.40	3.60
C1	0.50	0.60	0.80
C2	3.71	4.00	4.31
D	0.20	0.28	0.36
L	3.00	3.30	3.60







ORDERING INFORMATION

TYPE NUMBER	TEMPERATURE	PACKAGE
SIT65176BDR	-40°C~85°C	SOP8
SIT65176BDGK	-40°C~85°C	MSOP8/VSSOP8/8μMAX
SIT65176BP	-40°C~85°C	DIP8

Tape/reel package is 2500 pieces