

## FEATURES

- 3.0V~5.5V Wide Power Range, Half-Duplex
- ESD Protection for RS-485 I/O Pins  $\pm 15\text{kV}$ , Human Body Model
- Bus Fault Tolerance and Withstand Voltage Reach  $\pm 15\text{V}$
- 1/8 Unit Load, Allow Up to 256 Transceivers on the Bus
- Driver Short-Circuit Output Protection
- Low Power Off Function
- Receiver Open-Circuit Failure Protection
- Strong Anti-Noise Ability
- Integrated Transient Voltage Suppression Function
- Data transmission up to 14Mbps in an electric noise environment
- Available in SOP8, DIP8, MSOP8/8 $\mu$ MAX/VSSOP8 and DFN3\*3-8 packages

## PRODUCT APPEARANCE



Provide green and environmentally friendly lead-free package

## DESCRIPTION

SIT3088E is a RS-485 transceiver with 3.0V~5.5V wide power supply, bus port ESD protection capacity of over 15kV HBM, bus withstand voltage range of  $\pm 15\text{V}$ , half duplex, low power consumption, and fully meet the requirements of TIA / EIA-485 standard.

SIT3088E includes a driver and a receiver, both of which can be enabled and closed independently. When both are disabled, both the driver and the receiver output are high resistance state. SIT3088E has 1/8 load, which allows 256 SIT3088E transceivers to be connected to the same communication bus. It can realize error-free data transmission up to 14Mbps.

SIT3088E has a working voltage range of 3.0~5.5V, and has the functions of fail-safe, current-limiting protection, over-voltage protection, etc.

## PIN CONFIGURATION

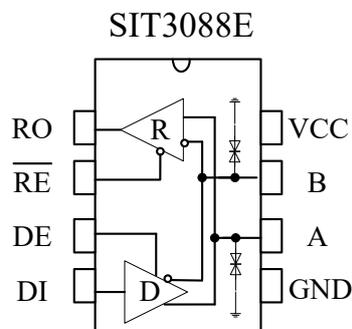


Figure 1 SIT3088E Pin Configuration

**PIN DESCRIPTION**

PIN	SYMBOL	DESCRIPTION
1	RO	Receiver Output. When /RE is low and if $A - B \geq -10\text{mV}$ , RO will be high; if $A - B \leq -200\text{mV}$ , RO will be low.
2	/RE	Receiver Output Enable. Drive /RE low to enable RO; RO is high impedance when /RE is high. Drive /RE high and DE low to enter low-power shutdown mode.
3	DE	Driver Output Enable. Drive DE high to enable driver outputs. These outputs are high impedance when DE is low. Drive /RE high and DE low to enter low-power shutdown mode.
4	DI	Driver Input. With DE high, a low on DI forces non-inverting output low and inverting output high. Similarly, a high on DI forces non-inverting output high and inverting output 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	Positive Supply.

**LIMITING VALUES**

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	VCC	+6.5	V
Control Input Voltage	/RE, DE, DI	-0.3~VCC+0.5	V
Receiver Input Voltage	A, B	-15~+15	V
Receiver Output Voltage	RO	-0.3~VCC+0.5	V
Operating Temperature Ranges	T <sub>A</sub>	-40~125	°C
Storage Temperature Range	T <sub>stg</sub>	-60~150	°C
Lead Temperature		300	°C
Continuous Power Dissipation	SOP8	470	mW
	MSOP8	830	mW
	DIP8	700	mW

The maximum limit parameters mean that exceeding these values may cause irreversible damage to the device. Under these conditions, it is not conducive 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.

**DRIVER DC ELECTRICAL CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Differential Driver Output (No load)	$V_{OD1}$		3		5.5	V
Differential Driver Output	$V_{OD2}$	Figure 2, $R_L = 54 \Omega$ , $V_{CC}=3.3V$	1.5		$V_{CC}$	V
		Figure 2, $R_L = 54 \Omega$ , $V_{CC}=5V$	1.5		$V_{CC}$	
Change in Magnitude of Driver Differential Output Voltage (NOTE1)	$\Delta V_{OD}$	Figure 2, $R_L = 54 \Omega$			0.2	V
Driver Common-Mode Output Voltage	$V_{OC}$	Figure 2, $R_L = 54 \Omega$			3	V
Change in Magnitude of Common-Mode Output Voltage (NOTE1)	$\Delta V_{OC}$	Figure 2, $R_L = 54 \Omega$			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	$\mu A$
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

(Unless otherwise noted, Temp= $T_{MIN}$ ~ $T_{MAX}$ , Temp=25°C).

NOTE1:  $\Delta V_{OD}$  and  $\Delta V_{OC}$  are the changes in  $V_{OD}$  and  $V_{OC}$ , respectively, when the DI input changes state.

**RECEIVER DC ELECTRICAL CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Input Current (A, B)	$I_{IN2}$	DE = 0 V, $V_{CC}=0$ or 3.3/5V $V_{IN} = 12 V$			125	$\mu A$

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Input Current (A, B)	$I_{IN2}$	DE = 0 V, VCC=0 or 3.3/5V $V_{IN} = -7$ V	-100			$\mu$ A
Positive Input Threshold Voltage	$V_{IT+}$	$-7V \leq V_{CM} \leq 12V$			-10	mV
Reverse Input Threshold Voltage	$V_{IT-}$	$-7V \leq V_{CM} \leq 12V$	-200			mV
Input Hysteresis Voltage	$V_{hys}$	$-7V \leq V_{CM} \leq 12V$	10	30		mV
Receiver Output High Voltage	$V_{OH}$	$I_{OUT} = -2.5mA$ , $V_{ID} = +200$ mV	VCC-1.5			V
Receiver Output Low Voltage	$V_{OL}$	$I_{OUT} = +2.5mA$ , $V_{ID} = -200$ mV			0.4	V
Three-State Output Current at Receiver	$I_{OZR}$	$0.4V < V_O < 2.4V$			$\pm 1$	$\mu$ A
Receiver Input Resistance	$R_{IN}$	$-7V \leq V_{CM} \leq 12V$	96			k $\Omega$
Receiver Short-Circuit Output Current	$I_{OSR}$	$0 V \leq V_O \leq VCC$	$\pm 8$		$\pm 90$	mA

(Unless otherwise noted, Temp= $T_{MIN}$ ~ $T_{MAX}$ , Temp=25°C).

## SUPPLY CURRENT

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	$I_{CC1}$	/RE=0V, DE = 0 V, VCC=3.3V		240	650	$\mu$ A
		/RE=0V, DE = 0 V VCC=5V		270	750	$\mu$ A
	$I_{CC2}$	/RE=VCC, DE=VCC, VCC=3.3V		250	650	$\mu$ A
		/RE=VCC, DE=VCC, VCC=5V		280	750	$\mu$ A
Shutdown Current	$I_{SHDN}$	/RE=VCC, DE=0V, VCC=3.3V		0.2	10	$\mu$ A
		/RE=VCC, DE=0V, VCC=5V		0.2	10	$\mu$ A

## DRIVER SWITCHING CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Driver Differential Output Delay	$t_{DD}$	$R_L = 60\Omega$ , $C_L = 100pF$ , <a href="#">Figure 3</a> & <a href="#">Figure 4</a>		20	40	ns
Driver Differential Output Transition Time	$t_{TD}$			12	28	ns
Drive Propagation Delay from Low to High	$t_{PLH}$	$R_L = 27\Omega$ , <a href="#">Figure 3</a> & <a href="#">Figure 4</a>		20	40	ns
Drive Propagation Delay from High to Low	$t_{PHL}$			20	40	ns
$ t_{PLH} - t_{PHL} $	$t_{PDS}$				1	8
Driver Enable to Output High	$t_{PZH}$	$R_L = 110\Omega$ , <a href="#">Figure 5</a> & <a href="#">Figure 6</a>			55	ns
Driver Enable to Output Low	$t_{PZL}$				55	ns
Driver Disable Time from Low	$t_{PLZ}$	$R_L = 110\Omega$ , <a href="#">Figure 5</a> & <a href="#">Figure 6</a>			85	ns
Driver Disable Time from High	$t_{PHZ}$				85	ns
In Shutdown mode, Enable to Output High	$t_{DSH}$	$R_L = 110\Omega$ , <a href="#">Figure 5</a> & <a href="#">Figure 6</a>		20	100	ns
In Shutdown mode, Enable to Output Low	$t_{DSL}$	$R_L = 110\Omega$ , <a href="#">Figure 5</a> & <a href="#">Figure 6</a>		20	100	ns

## RECEIVER SWITCHING CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Receiver Input to Output from Low to High	$t_{RPLH}$	$C_L = 15pF$ <a href="#">Figure 7</a> & <a href="#">Figure 8</a>		60		ns
Receiver Input to Output from High to Low	$t_{RPHL}$				60	ns
$ t_{RPLH} - t_{RPHL} $	$t_{RPDS}$				3	10

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Receiver Enable to Output Low	$t_{RPZL}$	$C_L=15pF$ <a href="#">Figure7</a> & <a href="#">Figure8</a>		15	40	ns
Receiver Enable to Output high	$t_{RPZH}$	$C_L=15pF$ <a href="#">Figure7</a> & <a href="#">Figure8</a>		15	40	ns
Receiver Disable Time from Low	$t_{RPLZ}$	$C_L=15pF$ <a href="#">Figure7</a> & <a href="#">Figure8</a>		25	55	ns
Receiver Disable Time from high	$t_{RPHZ}$	$C_L=15pF$ <a href="#">Figure7</a> & <a href="#">Figure8</a>		25	55	ns
In Shutdown Mode, Enable to Output High	$t_{RPSH}$	$C_L=15pF$ <a href="#">Figure7</a> & <a href="#">Figure8</a>		150	500	ns
In Shutdown Mode, Enable to Output Low	$t_{RPSL}$	$C_L=15pF$ <a href="#">Figure7</a> & <a href="#">Figure8</a>		150	500	ns
Time to Shutdown	$t_{SHDN}$	NOTE2	50		300	ns

NOTE2: If the enable inputs are RE=high and DE=low for less than 50ns, 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 Function**

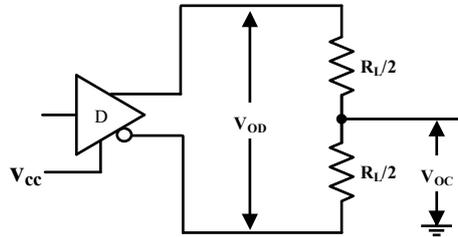
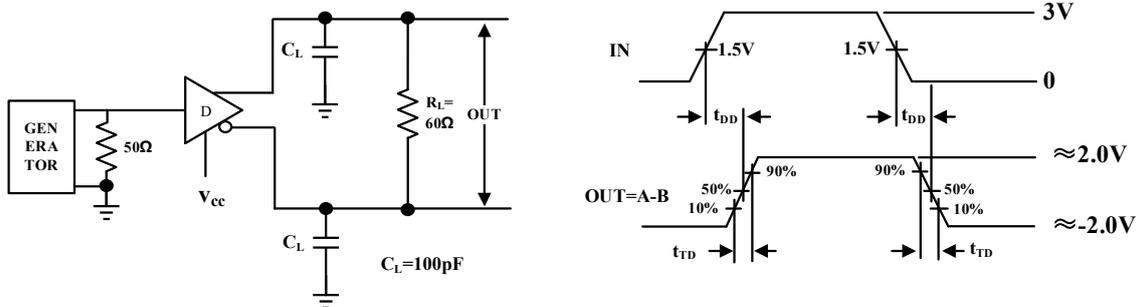
CONTROL		INPUT	OUTPUT	
/RE	DE	DI	A	B
X	1	1	H	L
X	1	0	L	H
0	0	X	Z	Z
1	0	X	Z(shutdown)	

X=irrelevant; Z=high impedance.

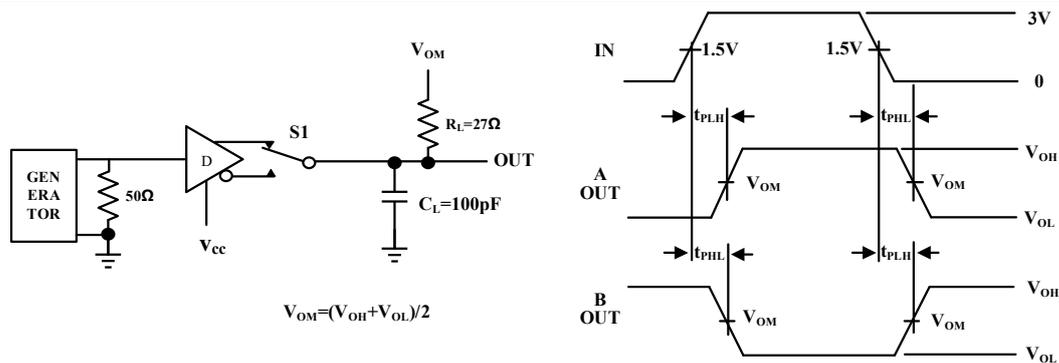
**Receiver Function**

CONTROL		INPUT	OUTPUT
/RE	DE	A-B	RO
0	X	$\geq -10mV$	H
0	X	$\leq -200mV$	L
0	X	Open/short circuit	H
1	X	X	Z

X=irrelevant; Z=high impedance.

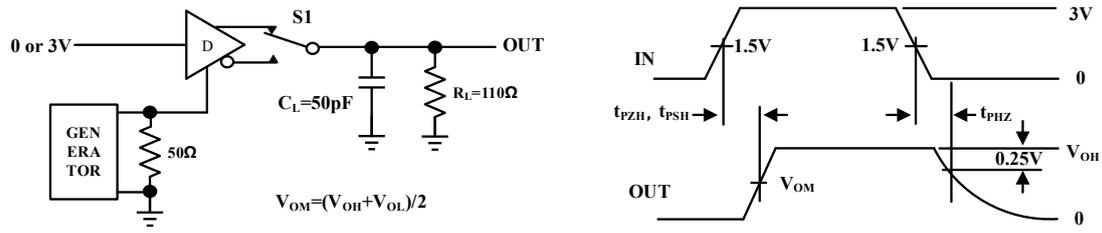
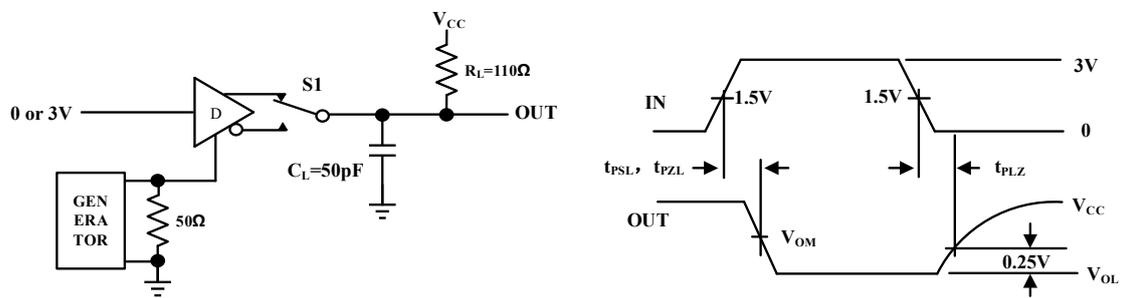
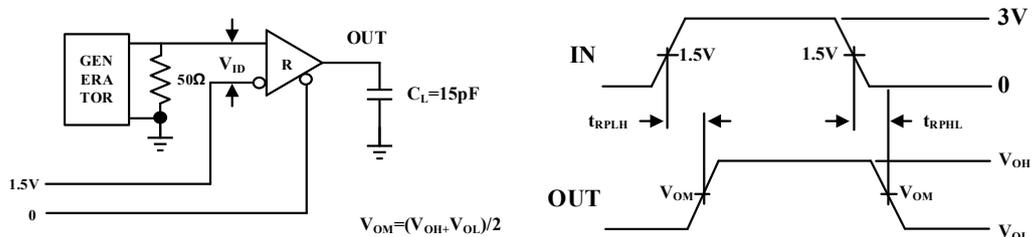
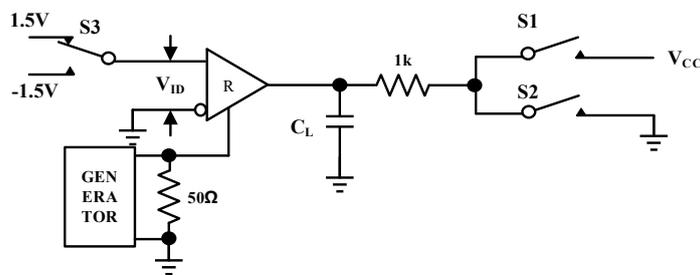
**TEST CIRCUIT**

**Figure 2 Driver DC test load**


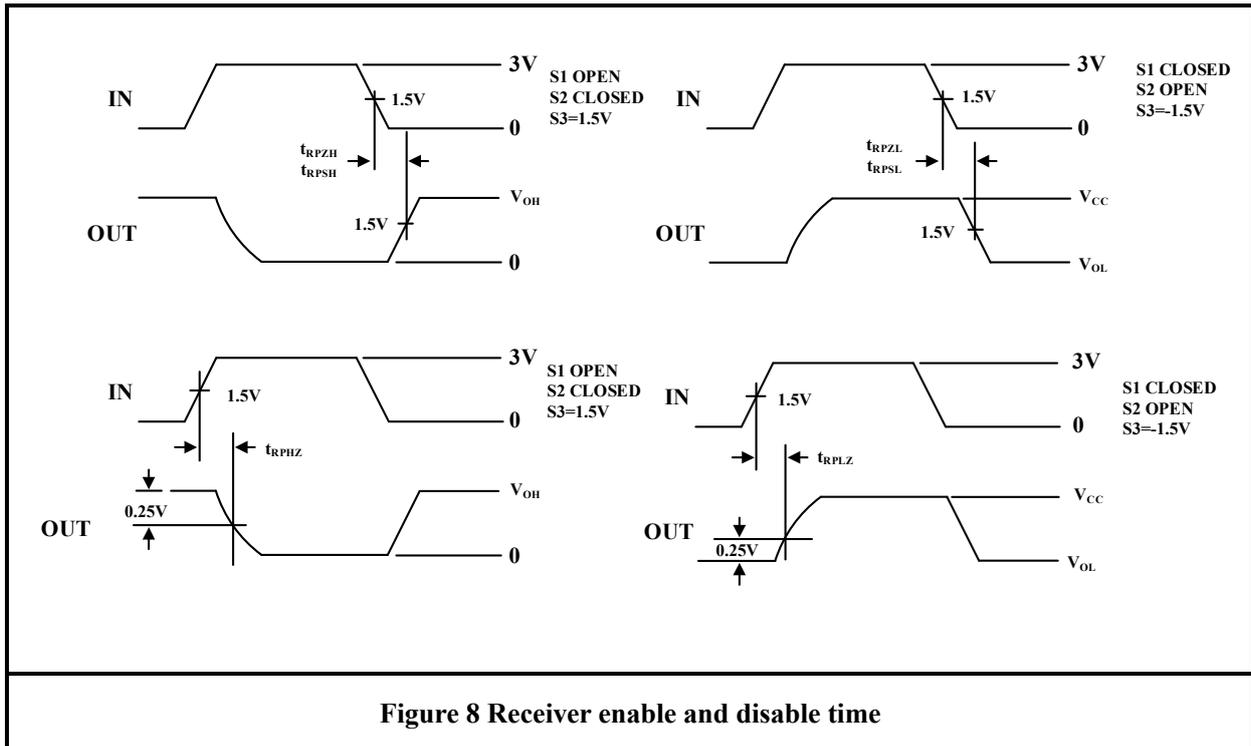
CL includes probe and stray capacitance (the same below)

**Figure 3 Differential delay and transmit time of driver**


$$V_{OM} = (V_{OH} + V_{OL}) / 2$$

**Figure 4 Drive propagation delay**


**Figure 5 Drive enable and disable time**

**Figure 6 Drive enable and disable time**

**Figure 7 Receiver propagation delay test circuit**




## ADDITIONAL DESCRIPTION

### 1 Sketch

SIT3088E is a half-duplex high-speed transceiver with 3.0V~5.5V wide power supply, bus port ESD protection capacity of more than 15kV HBM, bus DC withstand voltage of more than  $\pm 15V$ , used for RS-485/RS-422 communication, including a driver and receiver. It has the functions of fail-safe, over-voltage protection and over-current protection. SIT3088E realizes error-free data transmission up to 14Mbps.

### 2 Allowing up to 256 transceivers on the bus

The input impedance of the standard RS485 receiver is  $12k\Omega$  (1 unit load), and the standard driver can drive up to 32 units loads. The receiver of SIT3088E transceiver has 1/8 unit load input impedance ( $96k\Omega$ ), which allows up to 256 transceivers to be connected on the same communication bus in parallel. These devices can be combined arbitrarily or with other RS485 transceivers. Any combination of these devices and/or other RS-485 transceivers with a total of 32 unit loads or less can be connected to the line.

### 3 Driver output protection

Over-current protection features fast short circuit protection in the mode voltage range (refer to typical operating characteristics), which can prevent excessive output current and power dissipation caused by faults or by bus contention.

### 4 Typical applications

4.1 Bus Networking: SIT3088E RS485 transceiver is designed for bidirectional data communication on multi-point bus transmission line. [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 reflection, terminal matching should be carried out at both ends of the transmission line with its characteristic impedance, and the length of branch lines outside the main line should be as short as possible.

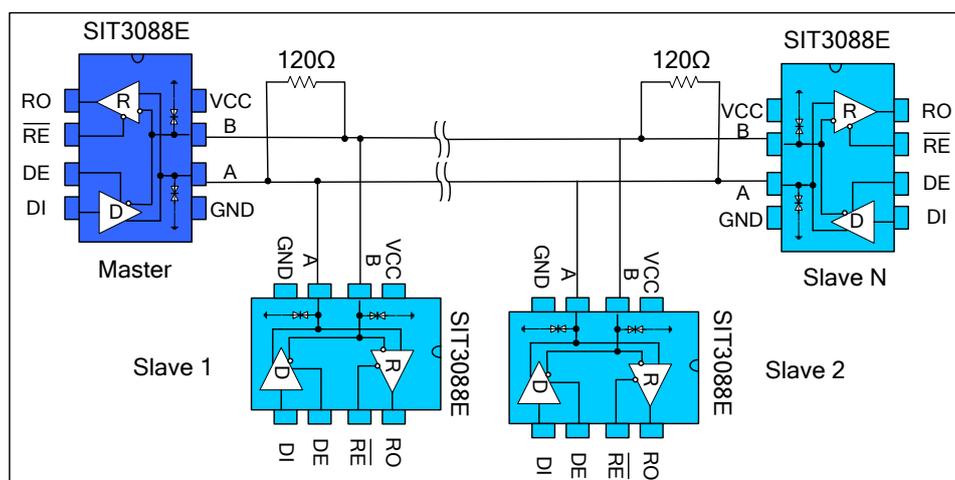


Figure 9 Bus type RS485 half-duplex communication network

4.2 Hand in hand Networking: also known as daisy chain topology, is the standard and specification of RS485 bus wiring, and is the RS485 bus topology recommended by TIA and other organizations. The wiring mode is that the main control equipment and a plurality of slave control equipment form a hand-held connection mode, as shown in [Figure 10](#), and the hand-held mode is no branches. This wiring mode has the advantages of small signal reflection and high communication success rate.

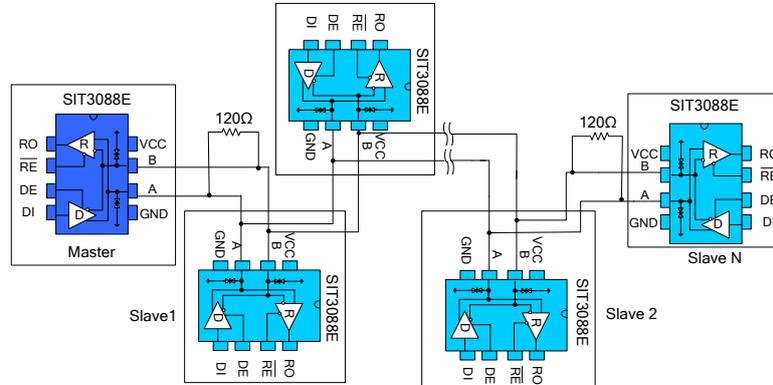


Figure10 Hand in hand RS485 half-duplex communication network

4.3 Bus port protection: in severe environment, RS485 communication port is usually provided with electrostatic protection, lightning surge protection and other additional protection, and even the plan to prevent 380V market electricity access is needed to avoid the damage of intelligent instrument and industrial control host. [Figure 11](#) shows three common RS485 bus port protection schemes. The first is the scheme of three-level protection by connecting TVS devices in parallel with A,B port to the protective ground, TVS devices in parallel with A,B port, thermistor in series with A,B port, gas discharge tube in parallel to the protective ground; the second is the scheme of three-level protection by connecting TVS in parallel with A,B port to the ground, thermistor in series with A,B port, and varistor in parallel with A,B port; the third is the scheme of three-level protection by connecting AB with pull-up or pull-down resistor to power and ground respectively, connecting TVS between A & B, A or B port connecting thermistor.

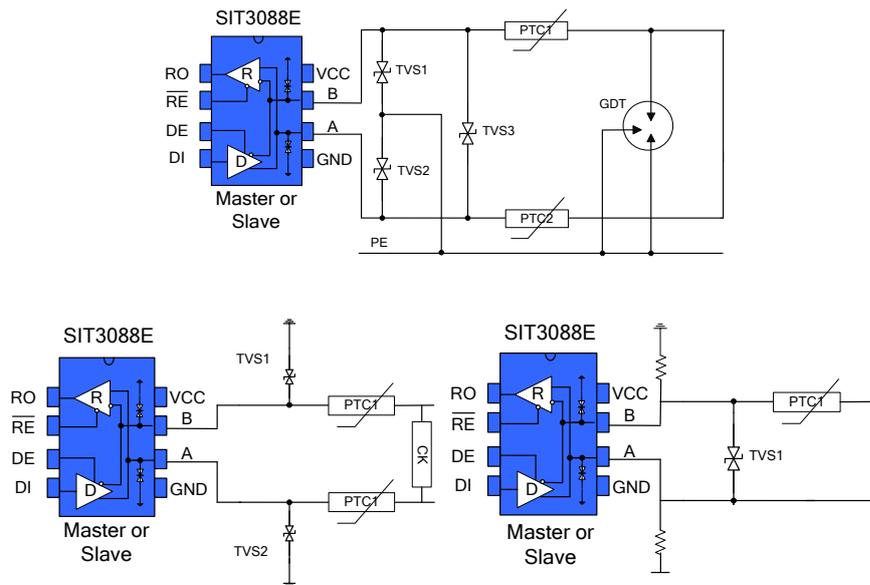
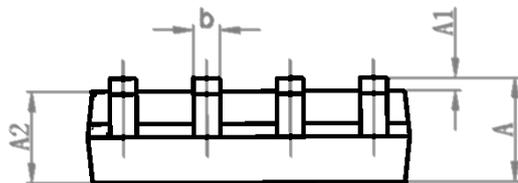
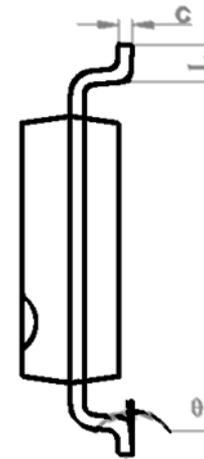
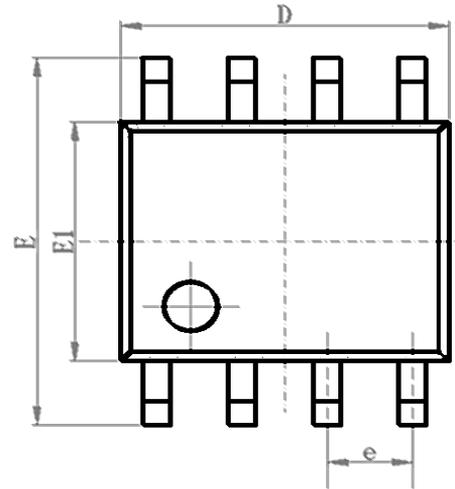


Figure 11 Port protection scheme

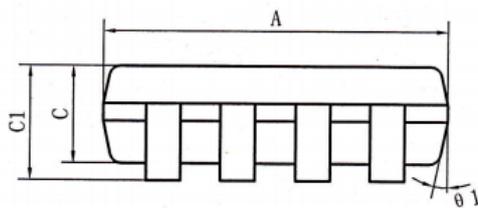
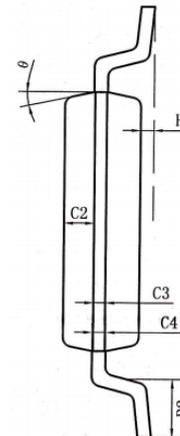
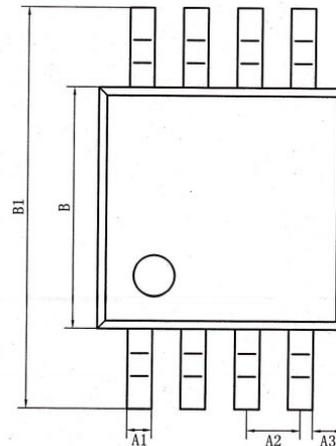
**SOP8 DIMENSIONS**
**PACKAGE SIZE**

SYMBOL	MIN./mm	TYP./mm	MAX./mm
A	1.40	-	1.80
A1	0.10	-	0.25
A2	1.30	1.40	1.50
b	0.38	-	0.51
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e		1.27BSC	
L	0.40	0.60	0.80
c	0.20	-	0.25
$\theta$	0°	-	8°



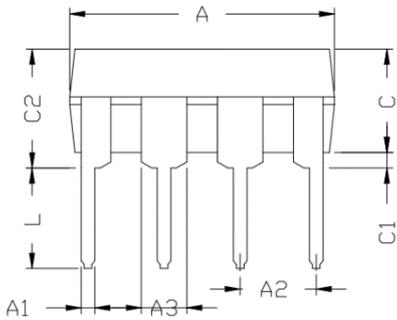
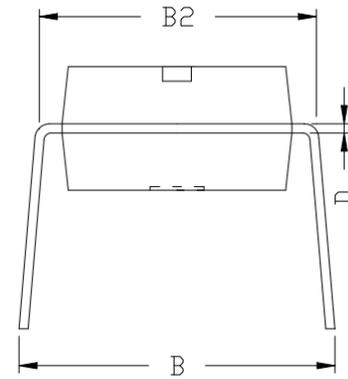
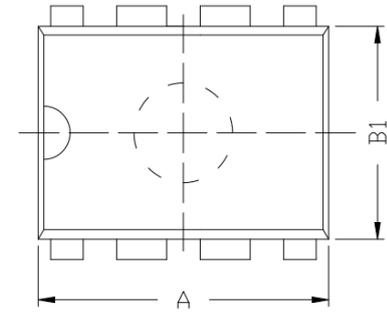
**MSOP8/8 $\mu$ MAX/VSSOP8 DIMENSIONS**
**PACKAGE SIZE**

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
$\theta$	12°TYP		



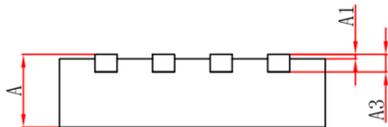
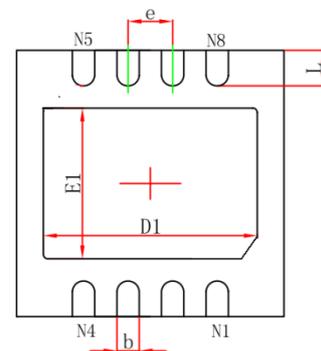
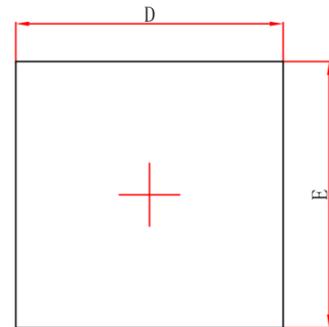
**DIP8 DIMENSIONS**
**PACKAGE SIZE**

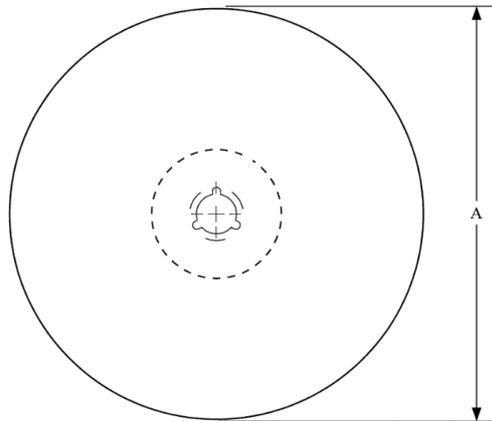
SYMBOL	MIN./mm	TYP./mm	MAX./mm
A	9.00	9.20	9.40
A1	0.33	0.45	0.51
A2	2.54TYP		
A3	1.525TYP		
B	8.40	8.70	9.10
B1	6.20	6.40	6.60
B2	7.32	7.62	7.92
C	3.20	3.40	3.60
C1	0.50	0.60	0.80
C2	3.71	4.00	4.31
D	0.20	0.28	0.36
L	3.00	3.30	3.60



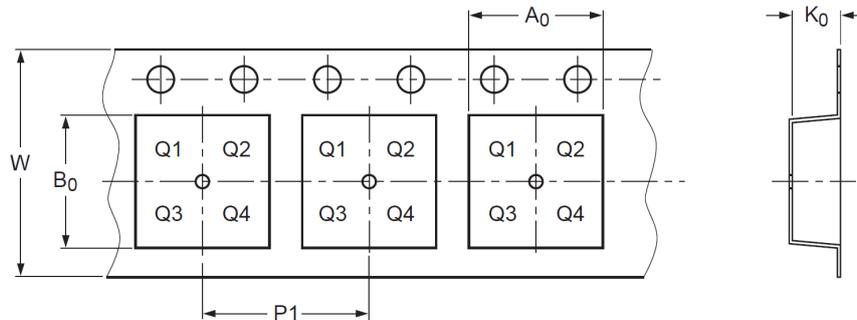
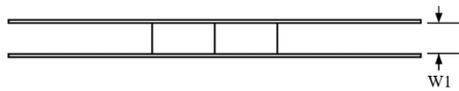
**DFN3\*3-8 DIMENSIONS**
**PACKAGE SIZE**

SYMBOL	MIN./mm	TYP./mm	MAX./mm
A	0.70		0.80
A1	0.00	0.02	0.05
A3	0.203 REF		
D	2.90	3.00	3.10
E	2.90	3.00	3.10
D1	2.35	2.45	2.55
E1	1.55	1.65	1.75
b	0.2	0.25	0.33
e	0.65 TYP		
L	0.35		0.45



**TAPE AND REEL INFORMATION**


A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers



Direction of Feed

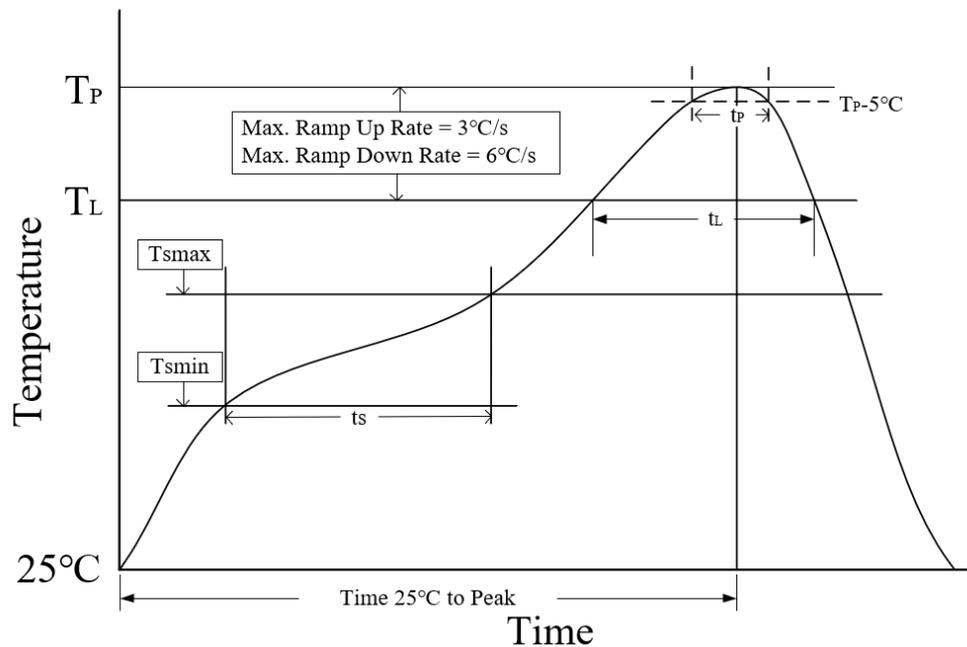
PIN1 is in quadrant 1

Package Type	Reel Diameter A (mm)	Tape width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)
SOP8	330	12.5±0.20	6.50±0.1	5.30±0.10	2.05±0.1	8.00±0.1	12.00±0.1
MSOP8	330	12.5±0.20	5.33±0.10	3.40±0.10	1.53±0.10	8.00±0.10	12.00 <sup>+0.30</sup> <sub>-0.10</sub>
DFN3*3-8	330	12.5±0.20	3.30±0.10	3.30±0.10	1.10±0.1	8.00±0.10	12.00 <sup>+0.30</sup> <sub>-0.10</sub>

**ORDERING INFORMATION**

TYPE NUMBER	PACKAGE	PACKING
SIT3088EESA	SOP8	Tape and reel
SIT3088EEUA	MSOP8/VSSOP8/8 $\mu$ MAX	Tape and reel
SIT3088EEPA	DIP8	Tube
SIT3088ETK	DFN3*3-8	Tape and reel

Tapered package is 2500 pcs/reel. The DFN3\*3-8 package is 5000 pcs/reel. DIP8 is packed with 50 pieces/tube in tubed packaging.

**REFLOW SOLDERING**


Parameter	Lead-free soldering conditions
Ave ramp up rate ( $T_L$ to $T_P$ )	$3^\circ\text{C/second max}$
Preheat time $t_s$ ( $T_{smin}=150^\circ\text{C}$ to $T_{smax}=200^\circ\text{C}$ )	60-120 seconds
Melting time $t_L$ ( $T_L=217^\circ\text{C}$ )	60-150 seconds
Peak temp $T_P$	$260-265^\circ\text{C}$
$5^\circ\text{C}$ below peak temperature $t_p$	30 seconds
Ave cooling rate ( $T_P$ to $T_L$ )	$6^\circ\text{C/second max}$
Normal temperature $25^\circ\text{C}$ to peak temperature $T_P$ time	8 minutes max

**Important statement**

SIT reserves the right to change the above-mentioned information without prior notice.

**REVISION HISTORY**

Version number	Data sheet status	Revision date
V1.0	Initial version.	January 2020
V1.1	Adjust the document format.	January 2020
V1.2	Adjust the document format.	February 2020
V1.3	Deleted parameters related to continuous power consumption; Added DFN3 * 3-8 related information.	March 2021
V1.4	Added the order quantity of DFN3*3-8 package per disc.	April 2020
V1.5	Updated $t_{DD}$ , $t_{TD}$ , $t_{PLH}$ , $t_{PHL}$ , and $t_{PDS}$ test conditions.	August 2020
V1.6	Updated the package information of SOP8 and DFN3*3-8; Increase the “important statement”.	January 2022
V1.7	Added the braid information; Added reflow information; Added the revision history.	November 2022
V1.8	Updated test diagrams;	December 2022