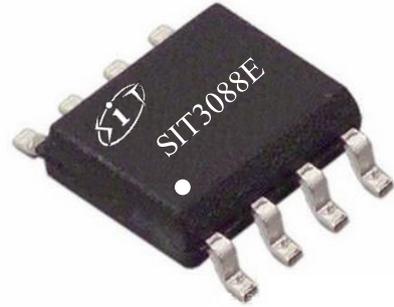


**FEATURES**

- 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
- Thermal-Shutdown Function
- 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

**OUTLINE**


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, over temperature protection, current-limiting protection, over-voltage protection, etc.

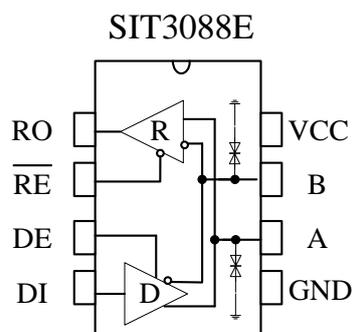
**PIN CONFIGURATION**


Figure 1 SIT3088E Pin Configuration

**LIMITING VALUES**

| PARAMETER                    | SYMBOL      | VALUE        | UNIT |
|------------------------------|-------------|--------------|------|
| Supply voltage               | VCC         | +7           | 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 |             | -40~125      | °C   |
| Storage Temperature Range    |             | -60~150      | °C   |
| Lead 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 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.

**PINNING**

| PIN | SYMBOL | DESCRIPTION   |
|-----|--------|---|
| 1   | RO     | Receiver Output. When /RE is low and if A - B $\geq$ -10mV, RO will be high; if A - B $\leq$ -200mV, 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   |

**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  |      | VCC  | V           |
|   |                 | Figure 2, $R_L = 54 \Omega$ , $V_{CC}=5V$   | 1.5  |      | VCC  |             |
| 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          |
| Over temperature shutdown threshold temperature                   |                 |   |      | 140  |      | $^{\circ}C$ |
| Overtemperature shutdown hysteresis temperature                   |                 |   |      | 20   |      | $^{\circ}C$ |

(Unless otherwise noted,  $Temp=T_{MIN} \sim T_{MAX}$ ,  $Temp=25^{\circ}C$ )

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 <sub>IN2</sub> | DE = 0 V,<br>VCC=0 或 3.3/5V<br>V <sub>IN</sub> = 12 V   |         |      | 125  | μA   |
|  |                  | DE = 0 V,<br>VCC=0 或 3.3/5V<br>V <sub>IN</sub> = -7 V   | -100    |      |      | μA   |
| Positive input threshold voltage       | V <sub>IT+</sub> | -7V ≦ V <sub>CM</sub> ≦ 12V                             |         |      | -10  | mV   |
| Reverse input threshold voltage        | V <sub>IT-</sub> | -7V ≦ V <sub>CM</sub> ≦ 12V                             | -200    |      |      | mV   |
| Input hysteresis voltage               | V <sub>hys</sub> | -7V ≦ V <sub>CM</sub> ≦ 12V                             | 10      | 30   |      | mV   |
| Receiver Output High Voltage           | V <sub>OH</sub>  | I <sub>OUT</sub> = -2.5mA,<br>V <sub>ID</sub> = +200 mV | VCC-1.5 |      |      | V    |
| Receiver Output Low Voltage            | V <sub>OL</sub>  | I <sub>OUT</sub> = +2.5mA,<br>V <sub>ID</sub> = -200 mV |         |      | 0.4  | V    |
| Three-State Output Current at Receiver | I <sub>OZR</sub> | 0.4 V < V <sub>O</sub> < 2.4 V                          |         |      | ±1   | μA   |
| Receiver Input Resistance              | R <sub>IN</sub>  | -7V ≦ V <sub>CM</sub> ≦ 12V                             | 96      |      |      | kΩ   |
| Receiver Short-Circuit Output Current  | I <sub>OSR</sub> | 0 V ≤ V <sub>O</sub> ≤ VCC                              | ±8      |      | ±90  | mA   |

 (Unless otherwise noted, Temp=T<sub>MIN</sub>~T<sub>MAX</sub>, Temp=25°C)

**SUPPLY CURRENT**

| PARAMETER      | SYMBOL           | CONDITION                        | MIN. | TYP. | MAX. | UNIT |
|----------------|------------------|----------------------------------|------|------|------|------|
| Supply Current | I <sub>CC1</sub> | /RE=0V,<br>DE = 0 V,<br>VCC=3.3V |      | 240  | 650  | μA   |
|                |                  | /RE=0V,<br>DE = 0 V<br>VCC=5V    |      | 270  | 750  | μA   |
|                | I <sub>CC2</sub> | /RE=VCC,<br>DE=VCC,              |      | 250  | 650  | μA   |

|                  |                   |                                |  |     |     |               |
|------------------|-------------------|--------------------------------|--|-----|-----|---------------|
|                  |                   | VCC=3.3V                       |  |     |     |               |
|                  |                   | /RE=VCC,<br>DE=VCC,<br>VCC=5V  |  | 280 | 750 | $\mu\text{A}$ |
| Shutdown current | $I_{\text{SHDN}}$ | /RE=VCC,<br>DE=0V,<br>VCC=3.3V |  | 0.2 | 10  | $\mu\text{A}$ |
|                  |                   | /RE=VCC,<br>DE=0V,<br>VCC=5V   |  | 0.2 | 10  | $\mu\text{A}$ |

### DRIVER SWITCHING CHARACTERISTICS

| PARAMETER                                  | SYMBOL           | CONDITION  | MIN. | TYP. | MAX. | UNIT |    |
|--|------------------|--|------|------|------|------|----|
| Driver differential Output delay           | $t_{\text{DD}}$  | $R_L = 60 \Omega$ ,<br>$C_{L1}=C_{L2}=100\text{pF}$<br>(figure3、4) |      | 20   | 40   | ns   |    |
| Driver differential output Transition time | $t_{\text{TD}}$  |  |      |      | 12   | 28   | ns |
| Drive propagation delay From low to high   | $t_{\text{PLH}}$ | $R_L = 27 \Omega$ ,<br>(figure3、4)                                 |      | 20   | 40   | ns   |    |
| Drive propagation delay From high to low   | $t_{\text{PHL}}$ |  |      |      | 20   | 40   | ns |
| $ t_{\text{PLH}}-t_{\text{PHL}} $          | $t_{\text{PDS}}$ |  |      |      | 1    | 8    | ns |
| Driver Enable to Output High               | $t_{\text{PZH}}$ | $R_L = 110\Omega$ ,<br>(figure5、6)                                 |      |      | 55   | ns   |    |
| Driver Enable to Output low                | $t_{\text{PZL}}$ |  |      |      | 55   | ns   |    |
| Driver Disable Time from Low               | $t_{\text{PLZ}}$ | $R_L = 110\Omega$ ,<br>(figure 5、6)                                |      |      | 85   | ns   |    |
| Driver Disable Time from high              | $t_{\text{PHZ}}$ |  |      |      | 85   | ns   |    |
| In Shutdown mode, Enable to Output High    | $t_{\text{DSH}}$ | $R_L = 110\Omega$ ,<br>(figure 5、6)                                |      | 20   | 100  | ns   |    |
| In Shutdown mode, Enable to Output low     | $t_{\text{DSL}}$ | $R_L = 110\Omega$ ,<br>(figure 5、6)                                |      | 20   | 100  | ns   |    |

**RECEIVER SWITCHING CHARACTERISTICS**

| PARAMETER                                 | SYMBOL     | CONDITION                       | MIN. | TYP. | MAX. | UNIT |
|---|------------|---------------------------------|------|------|------|------|
| Receiver Input to output from low to high | $t_{RPLH}$ | $C_L=15pF$<br>Figure7 & Figure8 |      | 60   |      | ns   |
| Receiver Input to output from high to low | $t_{RPHL}$ |                                 |      | 60   |      | ns   |
| $ t_{RPLH} - t_{RPHL} $                   | $t_{RPDS}$ |                                 |      | 3    | 10   | ns   |
| Receiver Enable to Output Low             | $t_{RPZL}$ | $C_L=15pF$<br>Figure7& Figure 8 |      | 15   | 40   | ns   |
| Receiver Enable to Output high            | $t_{RPZH}$ | $C_L=15pF$<br>Figure7 & Figure8 |      | 15   | 40   | ns   |
| Receiver Disable Time from Low            | $t_{PRLZ}$ | $C_L=15pF$<br>Figure7 & Figure8 |      | 25   | 55   | ns   |
| Receiver Disable Time from high           | $t_{PRHZ}$ | $C_L=15pF$<br>Figure7 & Figure8 |      | 25   | 55   | ns   |
| In Shutdown mode, Enable to Output High   | $t_{RPSH}$ | $C_L=15pF$<br>Figure7 & Figure8 |      | 150  | 500  | ns   |
| In Shutdown mode, Enable to Output low    | $t_{RPSL}$ | $C_L=15pF$<br>Figure7 & Figure8 |      | 150  | 500  | ns   |
| Time to Shutdown                          | $t_{SHDN}$ | NOTE2                           | 50   |      | 300  | ns   |

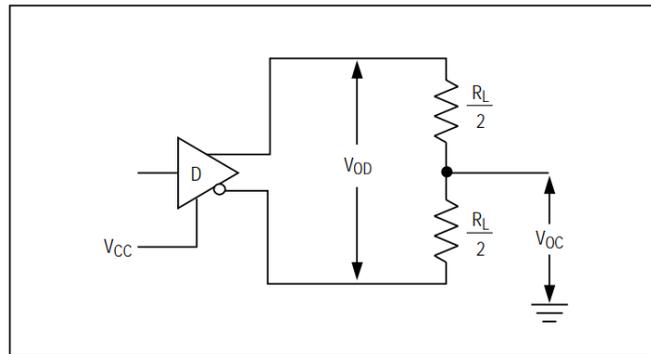
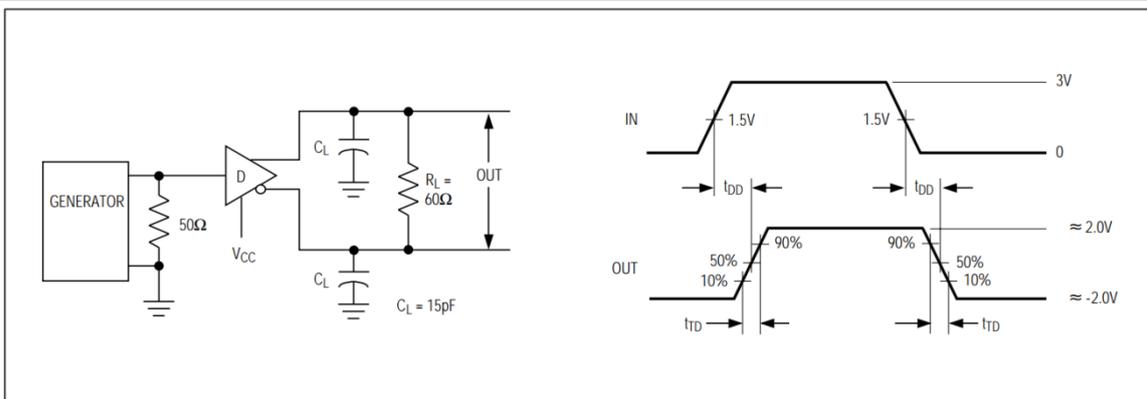
NOTE2: If the enable inputs are RE=high and DE=low for less than 50ns, the device is guaranteed not to enter shutdown. If the enable inputs are in this state for at least 300ns, the device is guaranteed to have entered shutdown.

**FUNCTION TABLE**
**Driver Function**

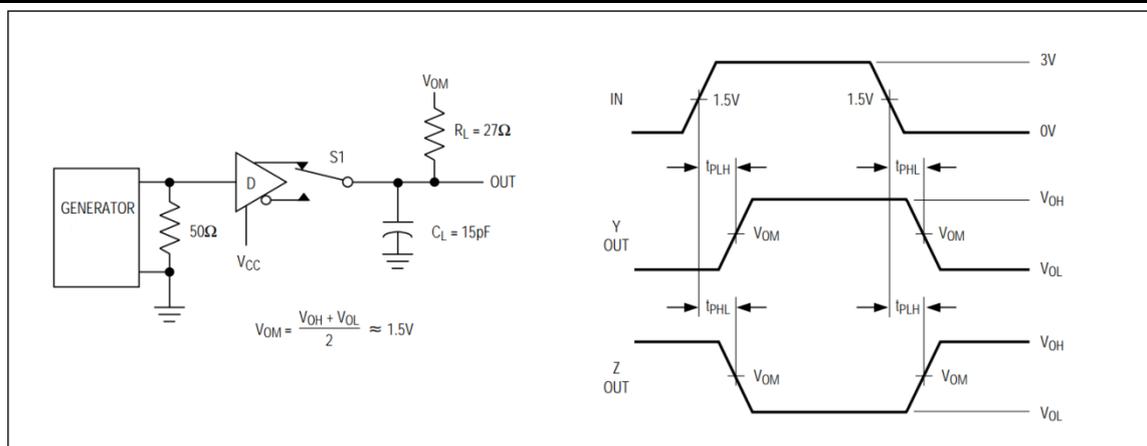
| CONTROL                        |    | INPUT | OUTPUT      |   |
|--------------------------------|----|-------|-------------|---|
| /RE                            | DE | DI    | A           | B |
| X                              | 1  | 1     | H           | L |
| X                              | 1  | 0     | L           | H |
| 0                              | 0  | X     | Z           | Z |
| 1                              | 0  | X     | Z(shutdown) |   |
| X=irrelevant; Z=high impedance |    |       |             |   |

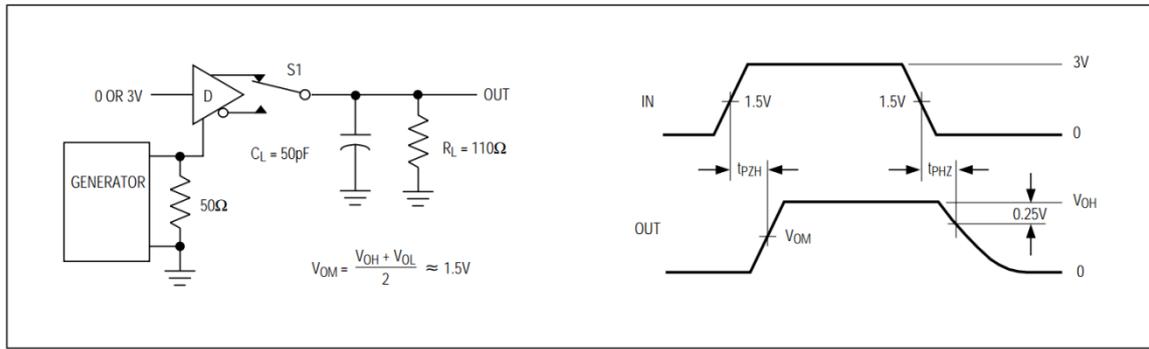
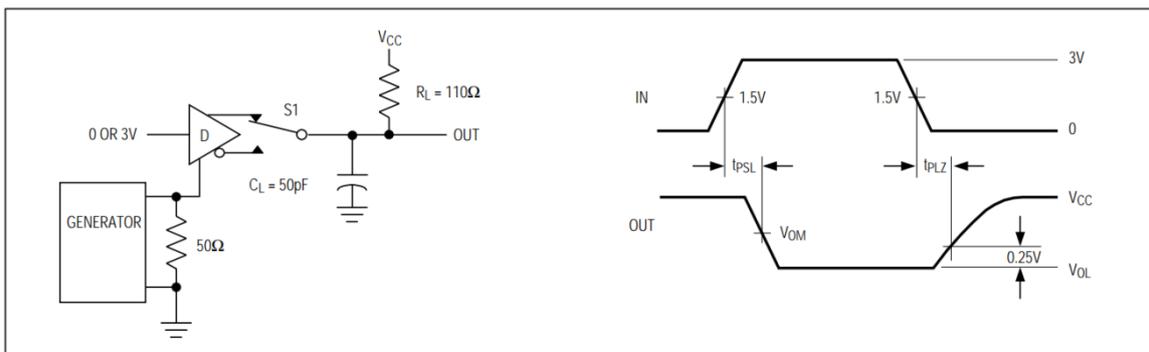
**Receiver Function**

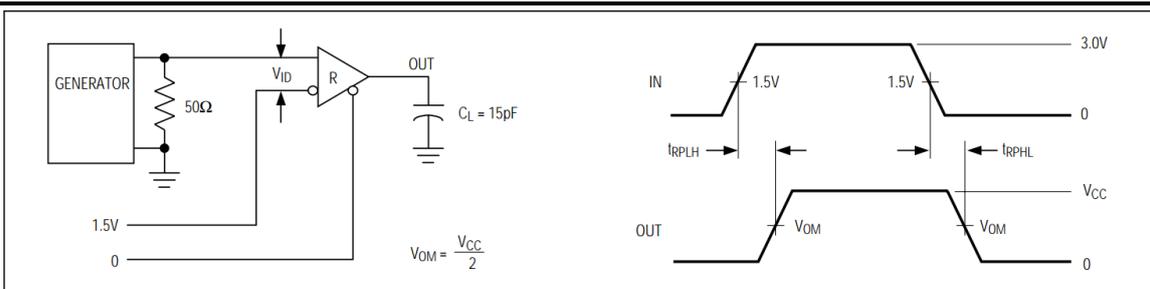
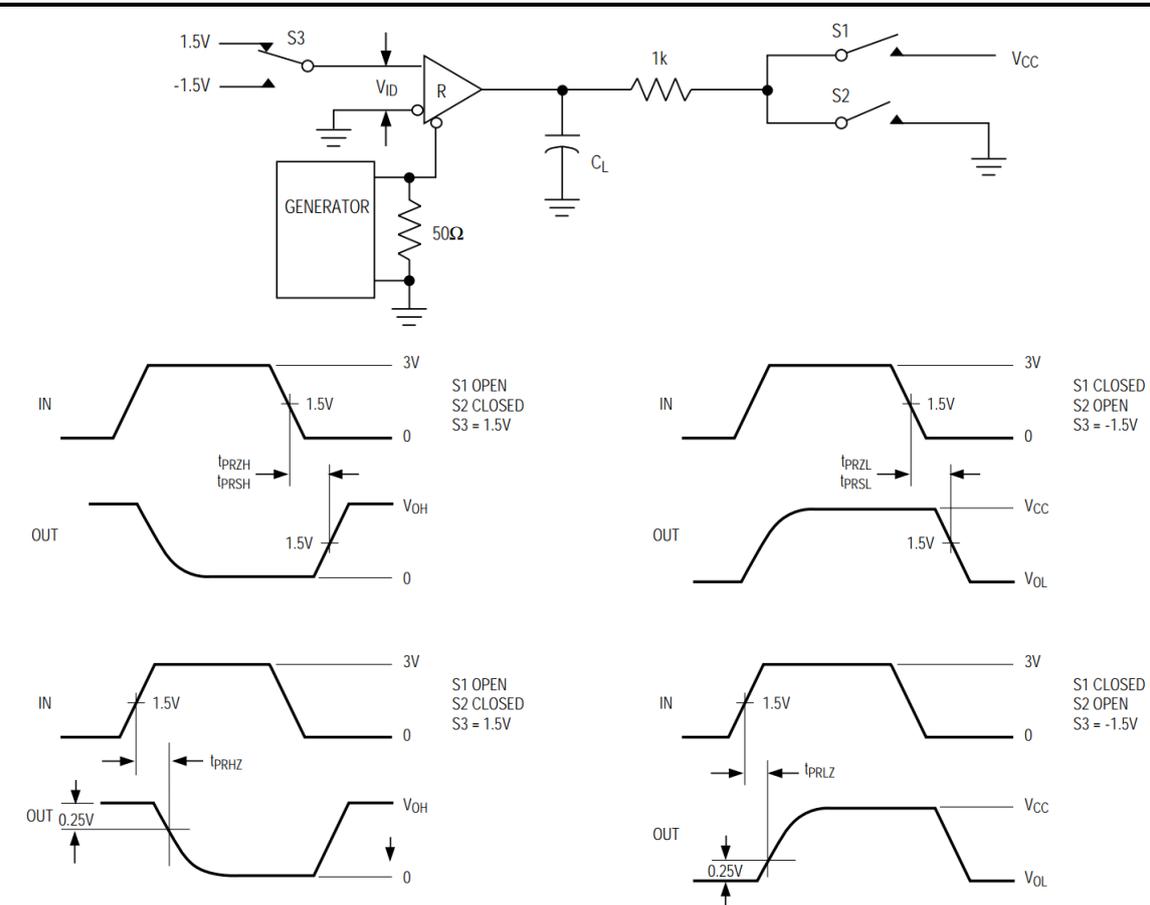
| CONTROL                        |    | INPUT                | OUTPUT |
|--------------------------------|----|----------------------|--------|
| /RE                            | DE | A-B                  | RO     |
| 0                              | X  | $\geq -10\text{mV}$  | H      |
| 0                              | X  | $\leq -200\text{mV}$ | 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 transit time of driver**

**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**

**Figure 8 Receiver enable and disable time**

**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, over-current protection and over temperature 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 unit 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**

Two mechanisms prevent excessive output current and power dissipation caused by faults or by bus contention. First, over-current protection, fast short circuit protection in the mode voltage range (refer to typical operating characteristics). Second, when the temperature of the tube core exceeds  $140^{\circ}C$ , the output of the driver is forced into the high resistance state.

**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.

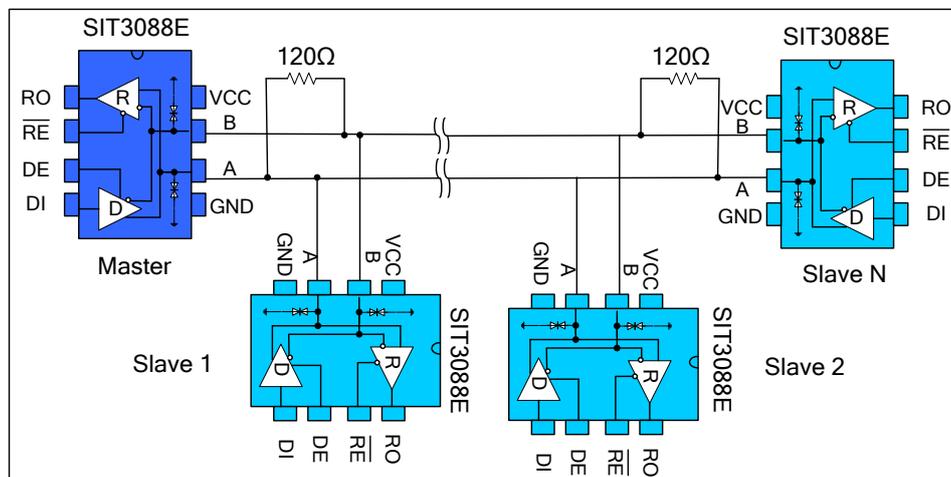


Figure 9 Bus type RS485 half duplex communication network

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.

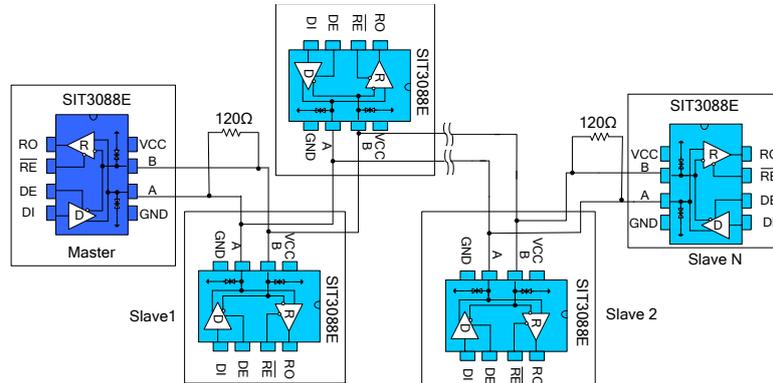


Figure10 Hand in hand RS485 half duplex communication network

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.

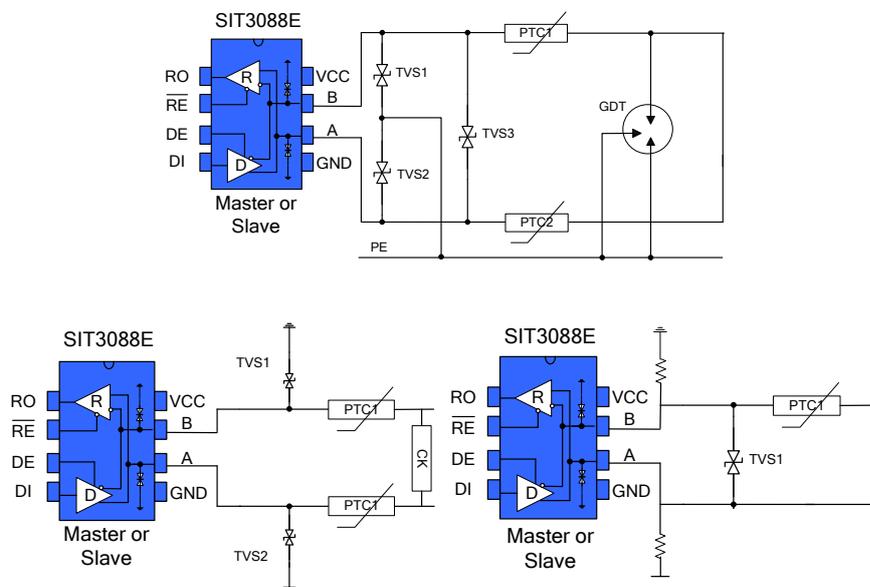
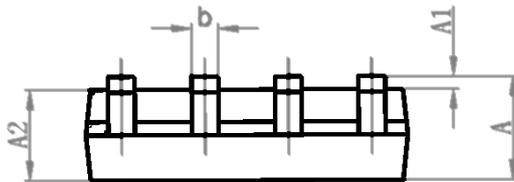
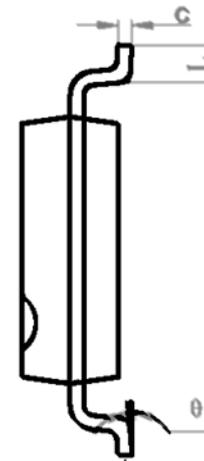
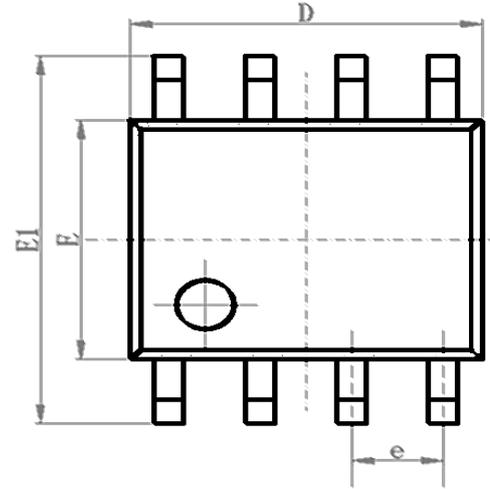


Figure 11 Port protection scheme

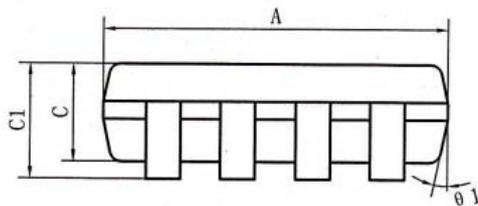
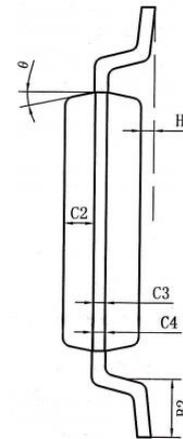
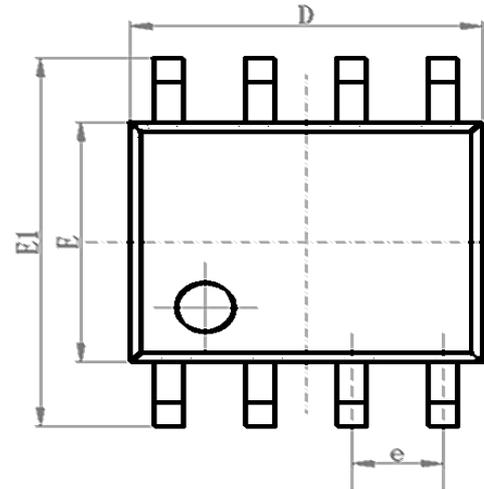
**SOP8 DIMENSIONS**
**PACKAGE SIZE**

| 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        | 3.80    | 3.90    | 4.00    |
| E1       | 5.80    | 6.00    | 6.20    |
| e        |         | 1.27BSC |         |
| L        | 0.40    | 0.60    | 0.80    |
| c        | 0.20    | -       | 0.25    |
| $\theta$ | 0°      | -       | 8°      |



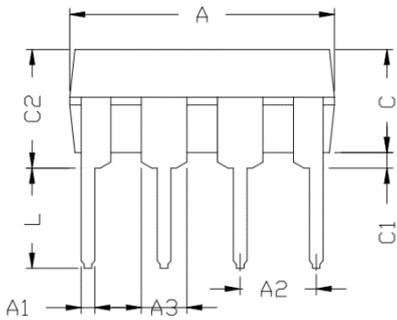
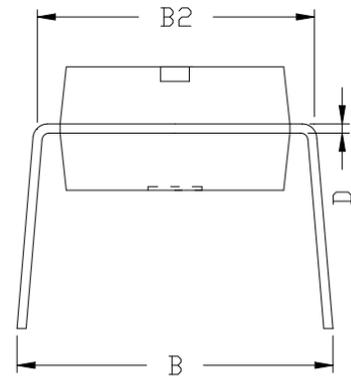
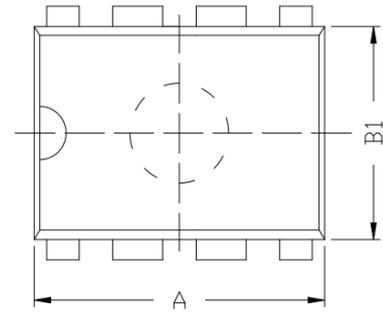
**MSOP8 / 8 $\mu$ MAX / VSSOP8 DIMENSIONS**
**PACKAGE SIZE**

| 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    |         |         |



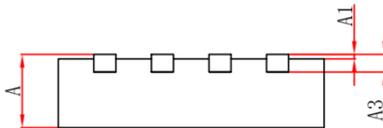
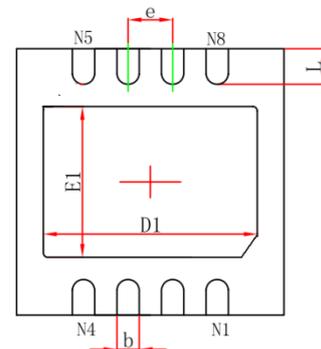
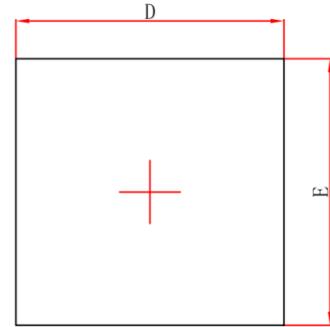
**DIP8 DIMENSIONS**
**Package size**

| 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 /HVSON8 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      | 2.3     | 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    |


**ORDERING INFORMATION**

| TYPE NUMBER | TEMPERATURE | PACKAGE            |
|-------------|-------------|--------------------|
| SIT3088EESA | -40°C~125°C | SOP8               |
| SIT3088EEUA | -40°C~125°C | MSOP8/VSSOP8/8μMAX |
| SIT3088EEPA | -40°C~125°C | DIP8               |
| SIT3088ETK  | -40°C~125°C | HVSON8/DFN3*3-8    |

Tapered package is 2500 pcs/reel. The HVSON8/DFN3\*3-8 package is 5000 pcs/reel.

**Important statement**

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