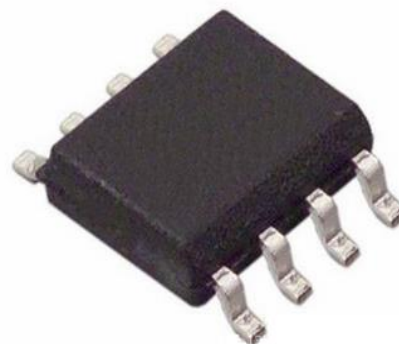


3.3-5.5V Supply $\pm 16\text{kV}$ ESD Protected 10Mbps, Half-duplex RS485/RS422 Transceiver

FEATURES

- 3V~5.5V power supply, half-duplex
- ESD protection for bus terminals:
contact discharge $\pm 16\text{kV}$
- Bus fault tolerance and withstand voltage reach $\pm 15\text{V}$
- 1/8-unit-load, allows up to 256 transceivers on the bus
- Driver short-circuit out protection
- Overtemperature protection function
- Low power shutdown function
- Receiver open-circuit failure protection
- Strong anti-noise ability
- Integrated transient voltage suppression function
- Data transmission up to 10Mbps in an electric noise environment

PRODUCT APPEARANCE



Provide Green and Environmentally
Friendly Lead-free package

DESCRIPTION

SL65HVD08 is a 3.0V~5.5V power supply, the contact discharge voltage of A/B is $\pm 16\text{kV}$, the fault protected voltage is $\pm 15\text{V}$, half-duplex, low power, RS485 Transceiver. SL65HVD08 fully meets the TIA/EIA-485 standard.

SL65HVD08 includes a driver and a receiver, both of which can be enabled and disabled independently. When both are disabled, the driver and receiver outputs are high resistance state. SL65HVD08 has a 1/8-unit-load receiver input impedance, that allows up to 256 transceivers on the bus. The SL65HVD08 allowing error-free data transmission up to 10Mbps.

SL65HVD08 has a working voltage range of 3.0V to 5.5V and has the functions of fail-safe, overtemperature protection, current-limiting protection and overvoltage protection.

PIN CONFIGURATION

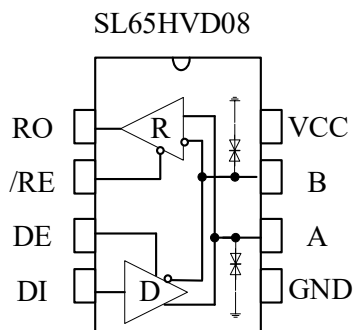


Fig 1 pin configuration

PIN DESCRIPTION

| PIN | SYMBOL | DESCRIPTION |
|-----|--------|---|
| 1 | RO | Receiver output. When /RE is low, if $A-B \geq 200$ mV, then RO=high. If $A-B \leq -200$ mV, then RO=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 | Power supply. |

LIMITING VALUES

| PARAMETER | SYMBOL | VALUE | UNIT |
|------------------------------|------------------|--------------|------|
| Supply Voltage | VCC | +7 | V |
| CTR Port | /RE, DE, DI | -0.3~VCC+0.5 | V |
| Driver Output Voltage | A, B | -15~15 | V |
| Receiver Output Voltage | RO | -0.3~VCC+0.5 | V |
| Operating Temperature Range | T _A | -40~85 | °C |
| Storage Temperature Range | T _{stg} | -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 | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|-----------------|---|------|-----|----------|-------------|
| Differential driver output (no load) | V_{OD1} | | 3.0 | | 5.5 | V |
| Differential driver output | V_{OD2} | Fig 2 , $R_L=54\Omega$, $V_{CC}=3.3V$ | | 2 | V_{CC} | V |
| | | Fig 2 , $R_L=54\Omega$, $V_{CC}=5.0V$ | | 3.5 | V_{CC} | |
| Change in magnitude of differential output voltage (NOTE1) | ΔV_{OD} | Fig 2 , $R_L=54\Omega$ | | | 0.2 | V |
| Driver common-mode Output Voltage | V_{OC} | Fig 2 , $R_L=54\Omega$ | | | 3 | V |
| Change in magnitude of common-mode voltage (NOTE1) | ΔV_{OC} | Fig 2 , $R_L=54\Omega$ | | | 0.2 | V |
| High-level input voltage | V_{IH} | DE, DI, /RE | 2.0 | | | V |
| Low-level input voltage | V_{IL} | DE, DI, /RE | | | 0.8 | V |
| Logic input current | I_{IN1} | DE, DI, /RE | -2 | | 2 | μA |
| Short-circuit output current, short to HIGH | I_{OSD1} | Short to 0V~12V | | | 250 | mA |
| Short-circuit output current, short to LOW | I_{OSD2} | Short to -7V~0V | -250 | | | mA |
| Thermal-shutdown threshold temperature | | | | 140 | | $^{\circ}C$ |
| Thermal-shutdown hysteresis temperature | | | | 20 | | $^{\circ}C$ |

(Unless otherwise stated, Temp= T_{MIN} ~ T_{MAX} , Temp= $25^{\circ}C$, $V_{CC}=5V$).

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

RECEIVER DC ELECTRICAL CHARACTERISTICS

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|------------------|--|---------|-----|------|-------|
| Input Current(A, B) | I _{IN2} | DE=0V, VCC=0 or 3.3/5V, V _{IN} =12V | | | 125 | μA |
| | | DE=0V, VCC=0 or 3.3/5V, V _{IN} =-7V | -100 | | | μA |
| 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 |
| Receiver input hysteresis voltage | V _{hys} | -7V≤V _{CM} ≤12V | 10 | 30 | | mV |
| HIGH-level output voltage | V _{OH} | I _{OUT} =-4mA, V _{ID} =+200mV | VCC-1.5 | | | V |
| LOW-level output voltage | V _{OL} | I _{OUT} =+4mA, V _{ID} =-200mV | | | 0.4 | V |
| Three-state input leakage current | I _{OZR} | 0.4V<V _O <2.4V | | | ±1 | μA |
| Receiver input resistance | R _{IN} | -7V≤V _{CM} ≤12V | 96 | | | kΩ |
| Receiver output short-circuit current | I _{OSR} | 0 V≤V _O ≤VCC | ±8 | | ±60 | mA |

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

SUPPLY CURRENT

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | |
|----------------|------------------|-------------------------|-----|-----|-----|-------|----|
| Supply Current | I _{CC1} | /RE=DE=0V, VCC=3.3V | | 430 | 650 | μA | |
| | | /RE=DE=0V, VCC=5V | | 470 | 750 | μA | |
| | I _{CC2} | /RE=DE=VCC, VCC=3.3V | | | 450 | 650 | μA |
| | | /RE=DE=VCC, VCC=5V | | | 510 | 750 | μA |

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|------------------|-------------------|--------------------------------|-----|-----|-----|-------|
| Shutdown current | I _{SHDN} | /RE=VCC, DE=0V, VCC=3.3V | | 0.4 | 10 | μA |
| | | /RE=VCC, DE=0V, VCC=5V | | 0.1 | 10 | μA |

DRIVER SWITCHING CHARACTERISTICS

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|------------------|---|-----|-----|------|-------|
| Driver Differential Output Delay | t _{DD} | R _L =60Ω, C _L =100pF, Fig 3 & Fig 4 | | 12 | 32 | ns |
| Driver Differential Output Transition Time | t _{TD} | | | | 15 | 28 |
| Driver Propagation Delay, Low-to-High Level | t _{DZH} | R _L =27Ω Fig 3 & Fig 4 | 18 | | 40 | ns |
| Driver Propagation Delay, High-to-Low Level | t _{DZL} | | 18 | | 40 | ns |
| t _{PLH} - t _{PHL} Driver Propagation-Delay Skew (Note 2) | t _{PDS} | | | | 2 | 2.5 |
| Driver-Output Enable Time to High Level | t _{PZH} | R _L =110Ω, Fig 5 & Fig 6 | | | 55 | ns |
| Driver-Output Enable Time to Low Level | t _{PZL} | | | | 55 | ns |
| Driver-Output Disable Time from Low Level | t _{PLZ} | R _L =110Ω, Fig 5 & Fig 6 | | | 85 | ns |
| Driver-Output Disable Time from High Level | t _{PHZ} | | | | 85 | ns |
| Driver-Output Enable Time from Shutdown to Low Level | t _{DSH} | R _L =110Ω, Fig 5 & Fig 6 | | 400 | 1000 | ns |

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|-----------|--|-----|-----|------|-------|
| Driver-Output Enable Time from Shutdown to High Level | t_{DSL} | $R_L=110\Omega$, Fig 5 & Fig 6 | | 400 | 1000 | ns |

RECEIVER SWITCHING CHARACTERISTICS

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|------------|---|-----|-----|------|-------|
| Receiver Propagation Delay (low to high) | t_{RPLH} | $C_L=15pF$ Fig 7 & Fig 8 | | 70 | | ns |
| Receiver Propagation Delay (high to low) | t_{RPHL} | $C_L=15pF$ Fig 7 & Fig 8 | | 70 | | ns |
| $ t_{RPLH} - t_{RPHL} $ | t_{RPDS} | $C_L=15pF$ Fig 7 & Fig 8 | | 5 | | ns |
| Receiver Enable to Output Low | t_{RPZL} | $C_L=15pF$ Fig 7 & Fig 8 | | 15 | | ns |
| Receiver Enable to Output High | t_{RPZH} | $C_L=15pF$ Fig 7 & Fig 8 | | 15 | | ns |
| Receiver Disable Time from Low | t_{RPLZ} | $C_L=15pF$ Fig 7 & Fig 8 | | 25 | 55 | ns |
| Receiver Disable Time from High | t_{RPHZ} | $C_L=15pF$ Fig 7 & Fig 8 | | 25 | 55 | ns |
| Receiver Enable from shutdown to Output High | t_{RPSH} | $C_L=15pF$ Fig 7 & Fig 8 | | 250 | 1500 | ns |
| Receiver Enable from Shutdown to Output Low | t_{RPSL} | $C_L=15pF$ Fig 7 & Fig 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 50ns, the device is guaranteed not to enter shutdown. If the enable inputs are in this state for at least 600ns, the device is guaranteed to have entered shutdown.

FUNCTION TABLES
TRANSMITTING

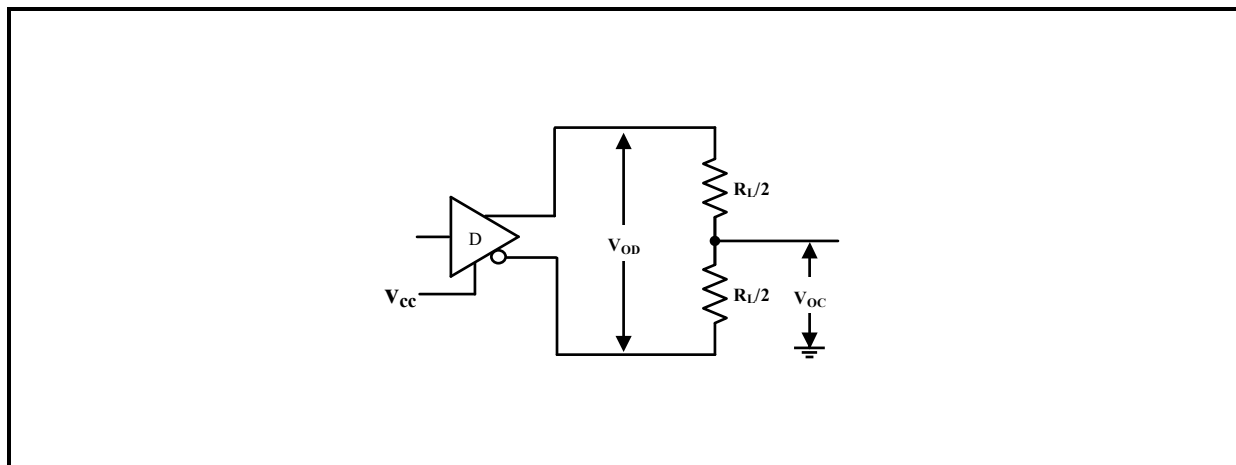
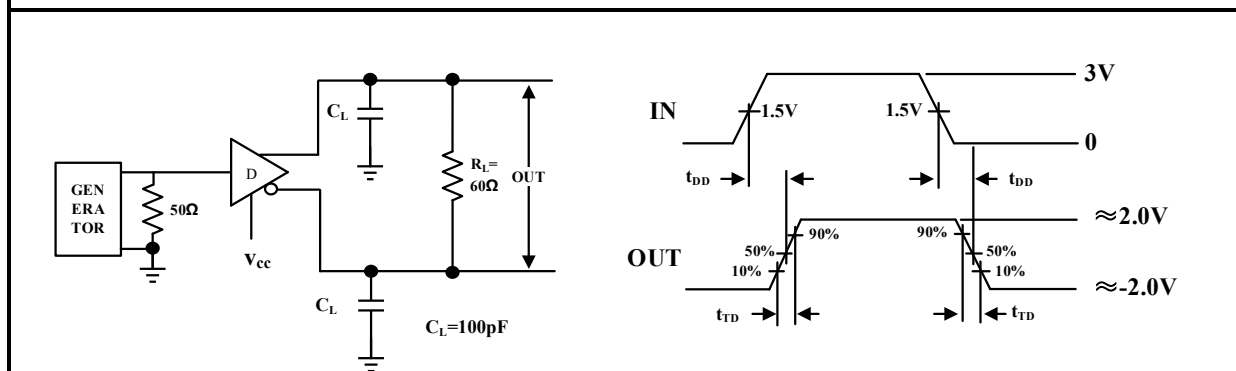
| CTR | | INPUTS | OUTPUTS | |
|-----|----|--------|-------------|---|
| /RE | DE | DI | A | B |
| X | 1 | 1 | H | L |
| X | 1 | 0 | L | H |
| 0 | 0 | X | Z | Z |
| 1 | 0 | X | Z(shutdown) | |

X: Don't care; Z: high impedance.

RECEIVING

| CTR | | INPUTS | OUTPUTS |
|-----|----|----------------------|---------|
| /RE | DE | A-B | RO |
| 0 | X | $\geq 200\text{mV}$ | H |
| 0 | X | $\leq -200\text{mV}$ | L |
| 0 | X | Open/shorted | H |
| 1 | X | X | Z |

X: Don't care; Z: high impedance.

TEST CIRCUIT

Fig 2 Driver DC Test Load


CL includes probe and stray capacitance, Same as below.

Fig 3 Driver Differential Output Delay and Transition Times

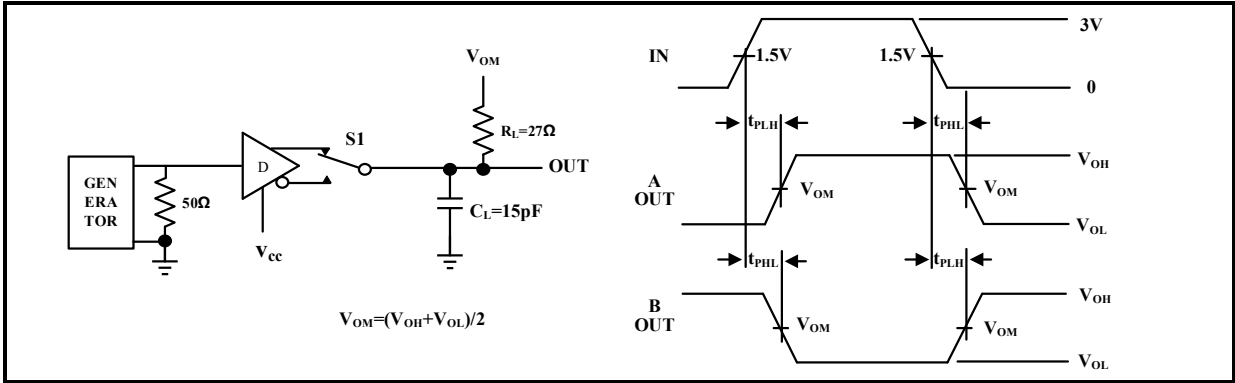


Fig 4 Driver Propagation Times

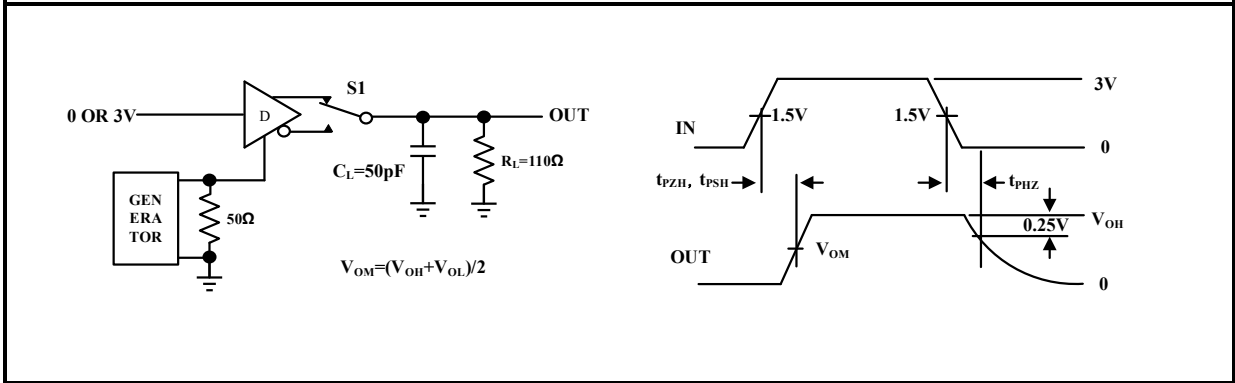


Fig 5 Driver Enable and Disable Times

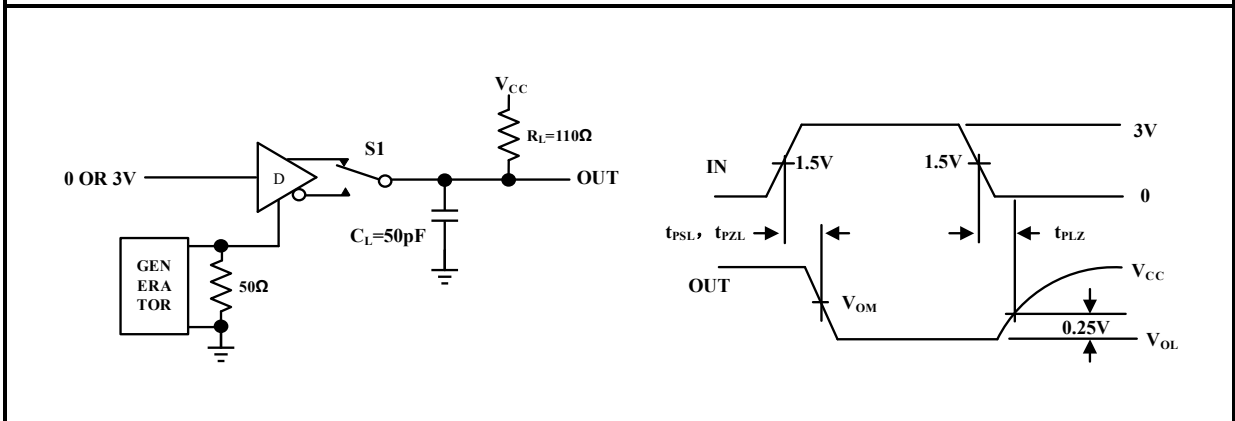


Fig 6 Driver Enable and Disable Times

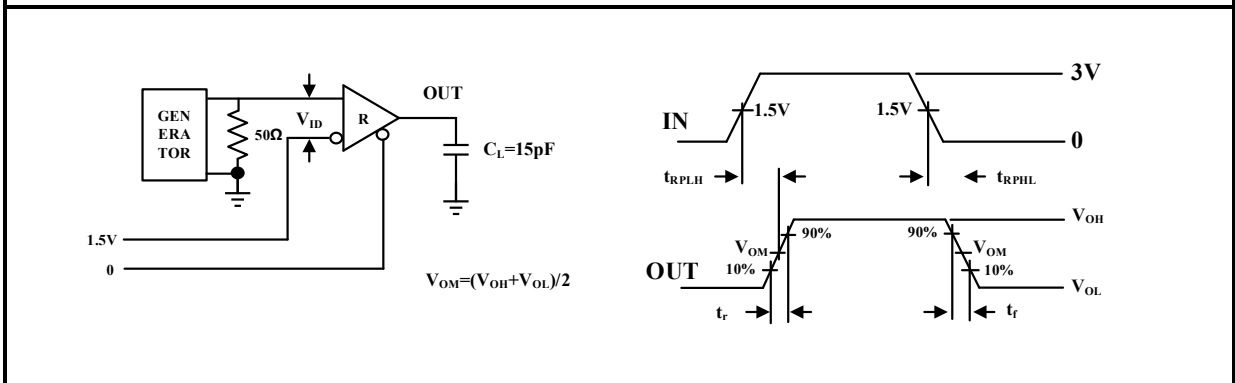


Fig 7 Receiver Propagation Delay

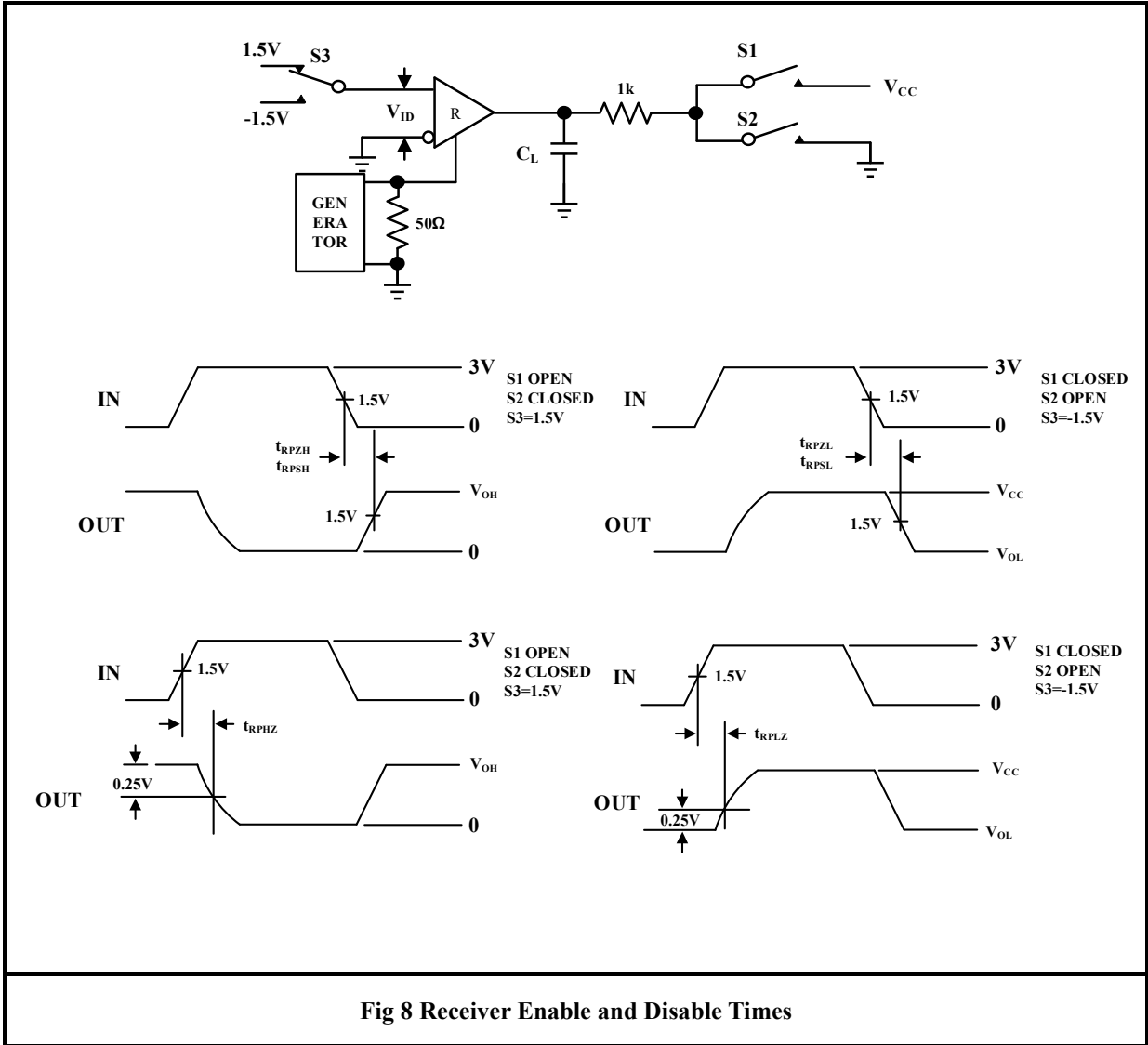


Fig 8 Receiver Enable and Disable Times

ADDITIONAL DESCRIPTION

1 Sketch

SL65HVD08 is a half-duplex high-speed transceiver with 3.0~5.5V wide power supply, $\pm 16\text{kV}$ contact discharge capacity and bus DC withstand voltage of more than $\pm 15\text{V}$, used for RS-485/RS-422 communication, including a driver and a receiver. It has the function of fail-safe, overvoltage protection, over-current protection and over temperature protection. The SL65HVD08 allows error-free data transmission up to 10Mbps.

2 Connecting 256 Transceivers on one Bus

The standard RS-485 receiver input impedance is $12\text{k}\Omega$ (1 unit load), the standard driver can drive up to 32 unit loads. Receiver SL65HVD08 transceiver has a $1/8$ unit load receiver input impedance ($96\text{k}\Omega$), allowing up to 256 transceivers to be connected in parallel on one bus. These devices can be any combination, or in combination with other RS-485 transceiver combination, as long as the total load does not load more than 32 units, can be connected on the same bus.

3 Drive 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°C , the output of the driver is forced into the high resistance state.

4 Typical Application

4.1 Bus Networking: SL65HVD08 RS485 transceiver is designed for bidirectional data communication on multi-point bus transmission line. Fig 9 shows a typical network application circuit. These devices can also be used as linear repeaters with cables longer than 4,000 feet. In order to reduce the 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.

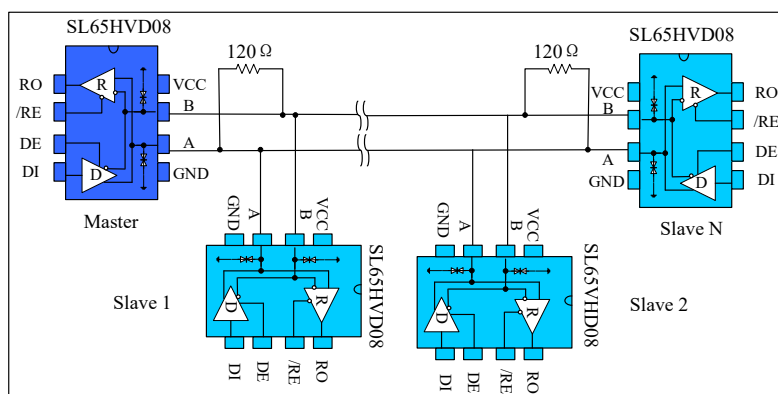


Fig 9 Bus type RS485 half-duplex communication network

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 Fig 10, and the hand-held mode is no branches. This wiring mode has the advantages of small signal reflection and high communication success rate.

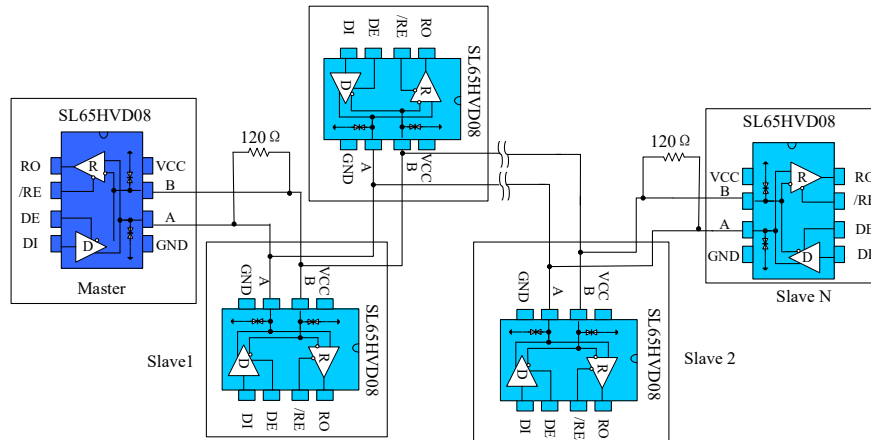


Fig 10 Hand in hand RS485 half-duplex communication network

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. Fig 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.

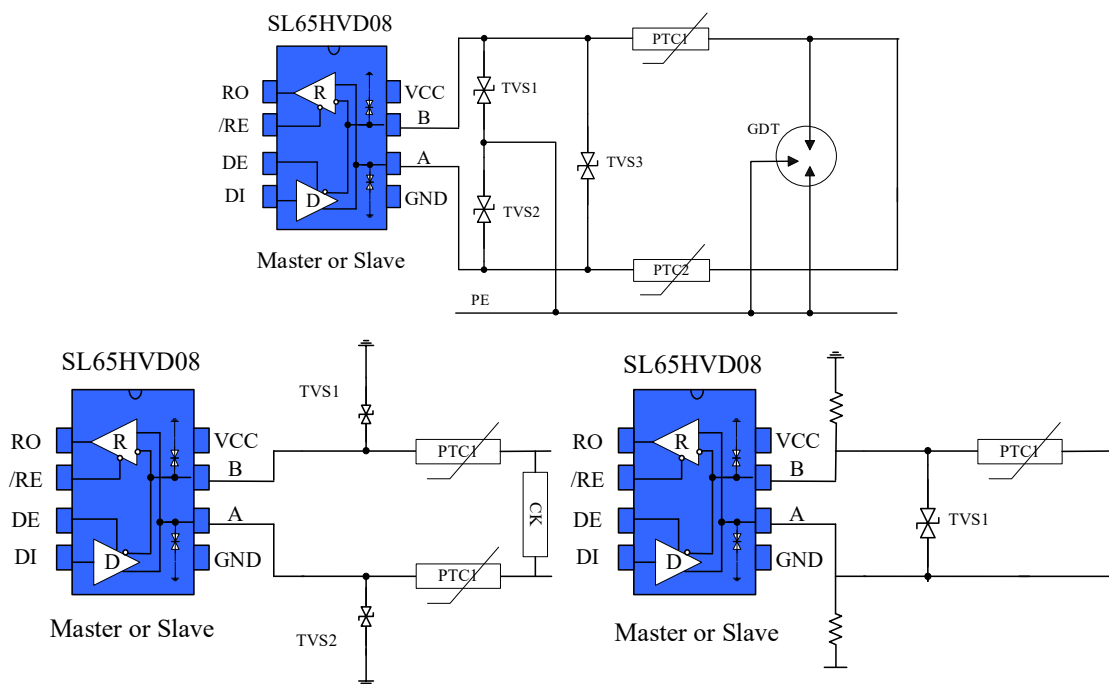
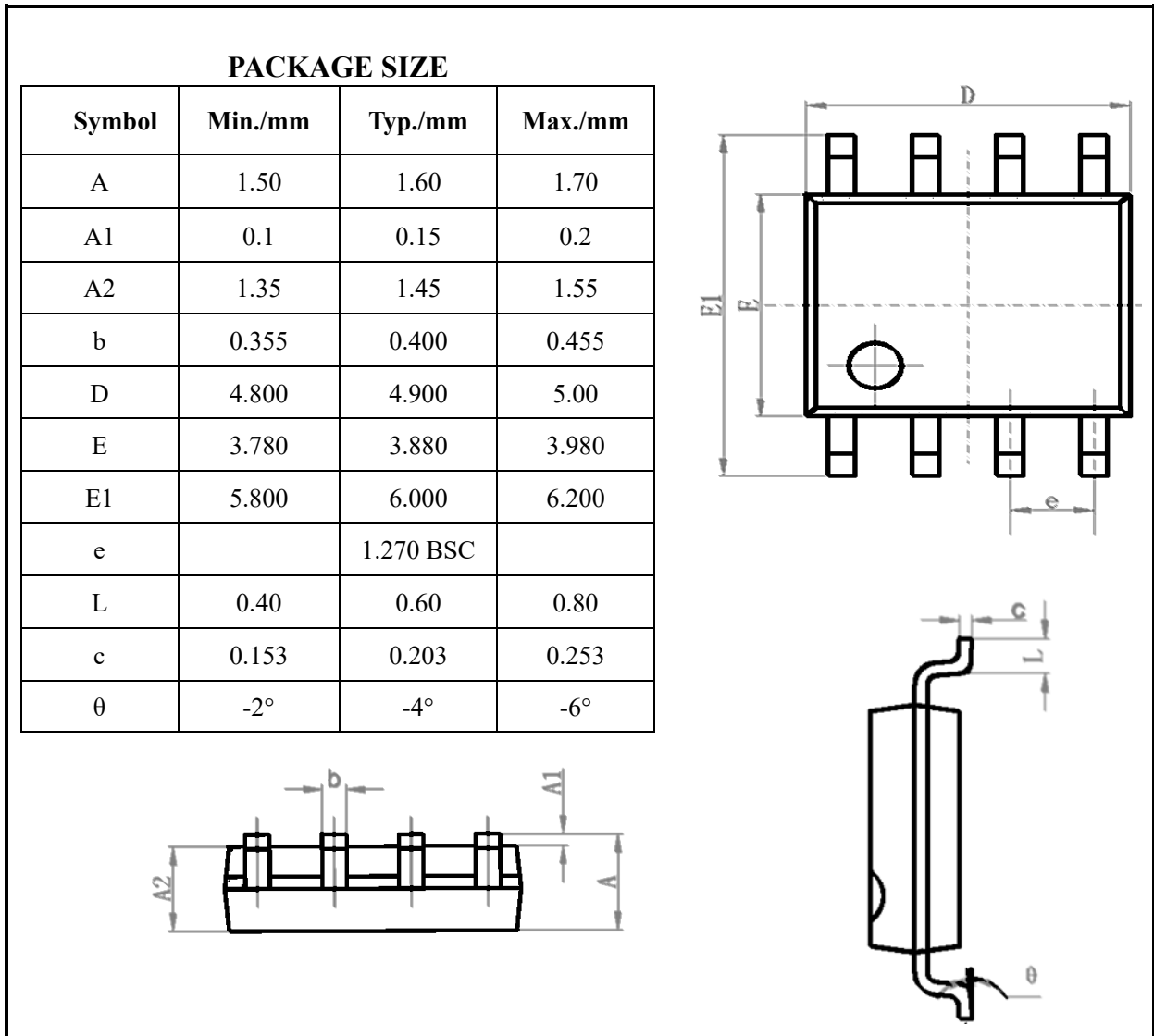
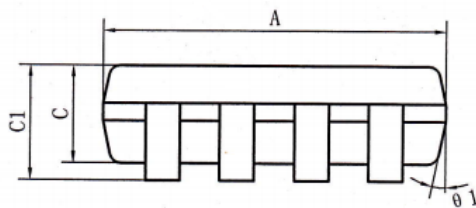
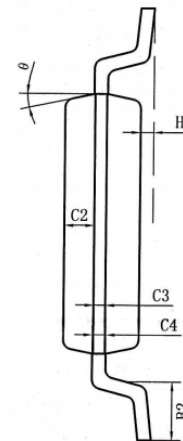
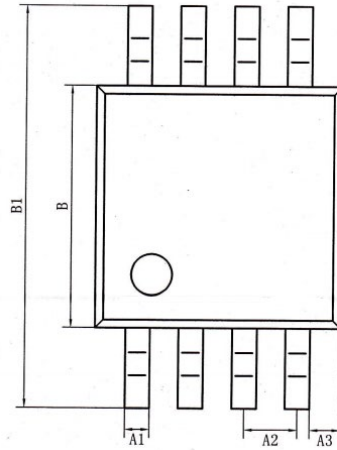


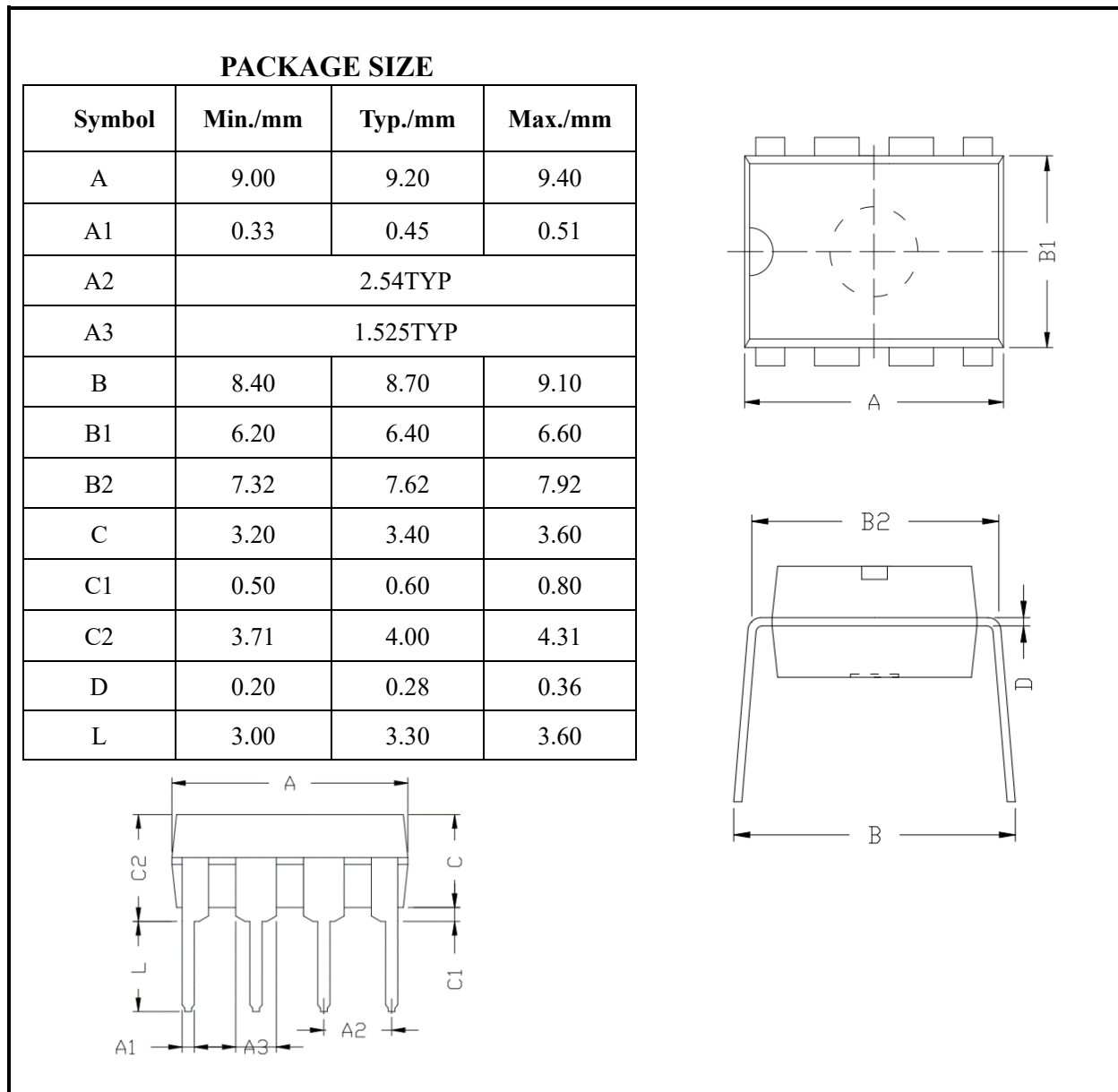
Fig 11 Port protection scheme

SOP8 DIMENSIONS


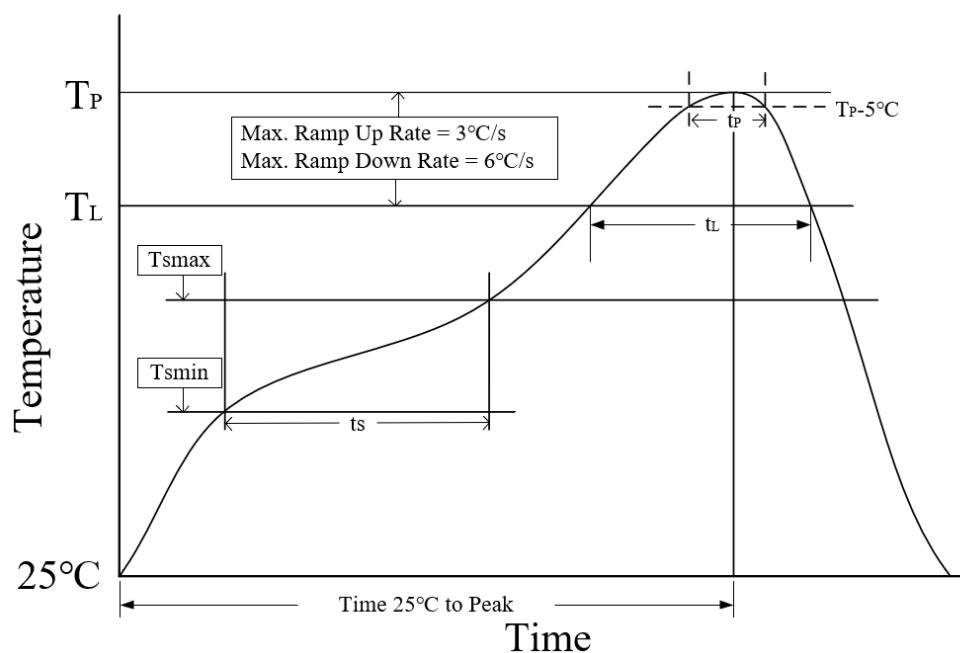
MSOP8/8 μ MAX/VSSOP8 DIMENSIONS
PACKAGE SIZE

| Symbol | Min./mm | Typ./mm | Max./mm |
|----------|-----------|---------|---------|
| A | 2.90 | 3.0 | 3.10 |
| A1 | 0.28 | | 0.35 |
| A2 | 0.65 TYP | | |
| A3 | 0.375 TYP | | |
| 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


REFLOW SOLDERING



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

ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | PACKING |
|--------------|--------------------|---------------|
| SL65HVD08DR | SOP8 | Tape and reel |
| SL65HVD08DGK | MSOP8/VSSOP8/8μMAX | Tape and reel |
| SL65HVD08P | DIP8 | Tube |

REVISION HISTORY

| Version number | Data sheet status | Revision date |
|-----------------------|--|------------------------------|
| V1.0 | Initial version. | August 2018 |
| V1.1~V1.4 | Adjusted format. | February 2018 to May 2018 |
| V1.5 | Added ESD protection related content. | June 2018 |
| V1.6 | Adjusted format. | August 2018 |
| V1.7 | Updated test circuit; Added tape and reel information; Updated ordering information; Added reflow soldering; Added revision history. | February 2023 |