## FEATURES

- Operates with a single 3.3V supply;
- Compatible with ISO 11898-2 standard;
- Bus pin ESD protection exceeds ±16 kV HBM;
- High input impedance allows for up to 120 nodes;
- Adjustable driver transition times for improved emissions performance;
- Designed for data rates up to 1 Mbps;
- Thermal Shutdown Protection;
- Open circuit fail-safe design;
- Glitch free power up and power down protection for hot plugging applications

## OUTLINE

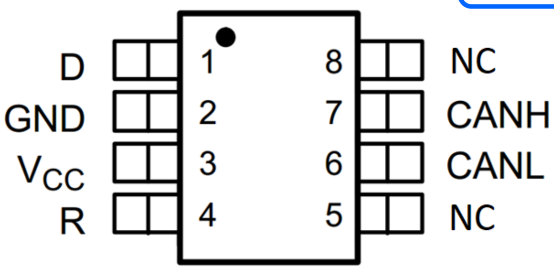

Provide green and environmentally friendly lead-free package

## DESCRIPTION

The SIT65HVD232 is the interface between the Controller Area Network (CAN) protocol controller and the physical bus. It is designed for use with the 3.3V µPs, MCUs and DSPs with CAN controllers, or with equivalent protocol controller devices. It is used in industrial automation, control, sensors and drive systems, motor and robotic control, building and climate control (HVAC), telecom and basestation control and status. The devices are intended for use in applications employing the CAN serial communication physical layer in accordance with the ISO 11898 standard.

| PARAMETER | SYMBOL | CONDITION | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| **Supply voltage** | $V_{cc}$ | | 3 | 3.6 | V |
| **Maximum transmission rate** | $1/t_{bit}$ | Non return to zero code | 1 | | Mbaud |
| **CANH/CANL input or output voltage** | $V_{can}$ | | -16 | +16 | V |
| **Bus differential voltage** | $V_{diff}$ | | 1.5 | 3.0 | V |
| **Virtual junction temperature** | $T_{amb}$ | | -40 | 125 | ℃ |

## PIN CONFIGURATION



## LIMITING VALUES

| PARAMETER | SYMBOL | VALUE | UNIT |
|---|---|---|---|
| **Supply voltage** | $V_{CC}$ | -0.3~+6 | V |
| **DC voltage on D/R pins** | D, R | -0.5~VCC+0.5 | V |
| **Voltage range at any bus terminal (CANH, CANL)** | CANL, CANH | -18~18 | V |
| **Transient voltage on pins 6, 7** | $V_{tr}$ | -25~+25 | V |
| **Receiver output current, $I_O$** | | -11~11 | mA |
| **Storage temperature** | | -40~150 | ℃ |
| **Virtual junction temperature** | | -40~125 | ℃ |
| **Welding temperature range** | | 300 | ℃ |
| **Continuous total power dissipation** | SOP8 | 400 | 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 opration 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** | D | CAN transmit data input (LOW for dominant and HIGH for recessive bus states), also called TXD, driver input |
| **2** | GND | Ground connection |
| **3** | VCC | Transceiver 3.3V supply voltage |
| **4** | R | CAN receive data output (LOW for dominant and HIGH for recessive bus states), also called RXD, receiver output |
| **5** | - | Not connected |
| **6** | CANL | Low level CAN bus line |
| **7** | CANH | High level CAN bus line |
| **8** | - | Not connected |

## BUS TRANSMITTER DC CHARACTERISTICS

| SYMBOL | PARAMETER | | CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{O(D)}$ | Output voltage (Dominant) | CANH | VI=0V, $R_L$=60Ω (Figure 1, Figure 2) | 2.45 | | VCC | V |
| | | CANL | | 0.5 | | 1.25 | |
| $V_{OD(D)}$ | Differential output voltage (Dominant) | | VI=0V, $R_L$=60Ω (Figure 1) | 1.5 | 2 | 3 | V |
| | | | VI=0V, $R_L$=60Ω, $R_S$ =0V (Figure 3) | 1.2 | 2 | 3 | V |
| $V_{O(R)}$ | Output voltage (Recessive) | CANH | VI=3V, $R_L$=60Ω (Figure 1) | | 2.3 | | V |
| | | CANL | | | 2.3 | | |
| $V_{OD(R)}$ | Differential output voltage (Recessive) | | VI=3V | -0.12 | | 0.012 | V |
| | | | VI=3V, NO LOAD | -0.5 | | 0.05 | V |
| $I_{IH}$ | High level input current | | VI=2V | -30 | | | μA |
| $I_{IL}$ | Low level input current | | VI=0.8V | -30 | | | μA |
| $I_{OS}$ | Short circuit output current | | CANH=-2V | -250 | | | mA |
| | | | CANH=7V | | | 1 | |
| | | | CANL=-2V | -1 | | | |
| | | | CANL=7V | | | 250 | |
| $C_O$ | Output capacitance | | See receiver | | | | |
| $I_{CC}$ | Supply current | | $V_I$=0V (Dominant), NO LOAD | | 10 | 17 | mA |
| | | | $V_I$=VCC (Recessive), NO LOAD | | 10 | 17 | mA |

(If not otherwise specified, $V_{CC}$=3.3V±10%, Temp=$T_{MIN}$~$T_{MAX}$, typical: $V_{CC}$=+3.3V, Temp=25°C)

## BUS TRANSMITTER SWITCHING CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation delay time (low-to-high level) | R=0, short circuit (Fig. 4) | | 35 | 85 | ns |
| | | R=10 kΩ | | 70 | 125 | |
| | | R=100 kΩ | | 500 | 870 | |
| $t_{PHL}$ | Propagation delay time (high-to-low level) | R=0, short circuit (Fig. 4) | | 70 | 120 | |
| | | R=10 kΩ | | 130 | 180 | |
| | | R=100 kΩ | | 870 | 1200 | |
| $t_{sk(p)}$ | Pulse skew (\| tPLH - tPHL \|) | R=0, short circuit (Fig. 4) | | 35 | | |
| | | R=10 kΩ | | 60 | | |
| | | R=100 kΩ | | 370 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **tr** | Differential output signal rise time | R=0, short circuit (Fig. 4) | 25 | 50 | 100 | |
| | | R=10 kΩ | 80 | 120 | 160 | |
| | | R=100 kΩ | 600 | 800 | 1200 | |
| **tf** | Differential output signal fall time | R=0, short circuit (Fig. 4) | 40 | 55 | 80 | |
| | | R=10 kΩ | 80 | 125 | 150 | |
| | | R=100 kΩ | 600 | 825 | 1000 | |

(If not otherwise specified, $V_{CC}$=3.3V±10%, Temp=$T_{MIN}$~$T_{MAX}$, typical: $V_{CC}$=+3.3V, Temp=25°C)

## BUS RECEIVER DC CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $V_{IT+}$ | Positive-going input threshold voltage | See Table 1 | | 750 | 900 | mV |
| $V_{IT-}$ | Negative-going input threshold voltage | See Table 1 | 500 | 650 | | mV |
| $V_{hys}$ | Hysteresis voltage | VIT+- VIT- | | 100 | | mV |
| $V_{OH}$ | High-level output voltage | -6V< $V_{ID}$ < 500mV<br>$I_O$=-8mA (see Fig. 5) | 2.4 | | | V |
| $V_{OL}$ | Low-level output voltage | 900mV< $V_{ID}$ < 6V<br>$I_O$=8mA (see Fig. 5) | | | 0.4 | V |
| $I_i$ | Bus input current | VIH=7V, VCC=0V | 100 | | 350 | µA |
| $I_i$ | | VIH=7V, VCC=3.3V | 100 | | 250 | µA |
| $I_i$ | | VIH=-2V ,VCC=0V | -100 | | -20 | µA |
| $I_i$ | | VIH=-2V, VCC=3.3V | -200 | | -30 | µA |
| $R_i$ | Input resistance | ISO 11898-2 standard | 20 | 35 | 50 | KΩ |
| $R_{diff}$ | Differential input resistance | ISO 11898-2 standard | 40 | | 100 | KΩ |
| $C_i$ | Input capacitance | ISO 11898-2 standard | | 40 | | pF |
| $C_{diff}$ | Differential input capacitance | ISO 11898-2 standard | | 20 | | pF |
| $I_{CC}$ | Supply current | See driver | | | | |

(If not otherwise specified, $V_{CC}$=3.3V±10%, Temp=$T_{MIN}$~$T_{MAX}$, typical: $V_{CC}$=+3.3V, Temp=25°C)

## BUS RECEIVER SWITCHING CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation delay time (low-to-high level) | Figure 6 | | 35 | 50 | ns |
| $t_{PHL}$ | Propagation delay time (high-to-low level) | Figure 6 | | 35 | 50 | ns |
| $t_{sk}$ | Pulse skew | $\|t_{PHL} - t_{PLH}\|$ | | | 10 | ns |
| $t_r$ | Output signal rise time | Figure 6 | | 1.5 | | ns |
| $t_f$ | Output signal fall time | Figure 6 | | 1.5 | | ns |

(If not otherwise specified, $V_{CC}$=3.3V±10%, Temp=$T_{MIN}$~$T_{MAX}$, typical: $V_{CC}$=+3.3V, Temp=25°C)

## DEVICE SWITCHING CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $t_{(LOOP1)}$ | Loop delay 1, driver input to receiver output, Recessive to Dominant | R=0, short circuit (Figure 7) | | 70 | 115 | ns |
| | | R=10 kΩ | | 105 | 175 | |
| | | R=100 kΩ | | 535 | 920 | |
| $t_{(LOOP2)}$ | Loop delay 2, driver input to receiver output, Dominant to Recessive | R=0, short circuit (Figure 7) | | 100 | 135 | ns |
| | | R=10 kΩ | | 155 | 185 | |
| | | R=100 kΩ | | 830 | 990 | |

(If not otherwise specified, $V_{CC}$=3.3V±10%, Temp=$T_{MIN}$~$T_{MAX}$, typical: $V_{CC}$=+3.3V, Temp=25°C)

## OVER TEMPERATURE PROTECTION

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Shutdown junction temperature | Tj(sd) | | 155 | 165 | 180 | ℃ |

(If not otherwise specified, $V_{CC}$=3.3V±10%, Temp=$T_{MIN}$~$T_{MAX}$, typical: $V_{CC}$=+3.3V, Temp=25°C)

## SUPPLY CURRENT

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Dominant power consumption | | $V_I$=0V, LOAD=60Ω | | 50 | 70 | mA |
| Recessive power consumption | | $V_I$=VCC, NO LOAD | | 6 | 10 | mA |

(If not otherwise specified, $V_{CC}$=3.3V±10%, Temp=$T_{MIN}$~$T_{MAX}$, typical: $V_{CC}$=+3.3V, Temp=25°C)

## FUNCTION TABLE

Table 1. Receiver characteristics over common mode ($V_{(RS)}$=1.2V)

| $V_{IC}$ | $V_{ID}$ | $V_{CANH}$ | $V_{CANL}$ | R OUTPUT | |
|---|---|---|---|---|---|
| -2 V | 900mV | -1.55V | -2.45V | L | VOL |
| 7 V | 900mV | 8.45V | 6.55V | L | |
| 1 V | 6V | 4V | -2V | L | |
| 4 V | 6V | 7V | 1V | L | |
| -2 V | 500mV | -1.75V | -2.25V | H | VOH |
| 7 V | 500mV | 7.25V | 6.75V | H | |
| 1 V | -6V | -2V | 4V | H | |
| 4 V | -6V | 1V | 7V | H | |
| X | X | Open | Open | H | |

(1) H=high level; L=low level; X=irrelevant

Table 2. Driver functions

| INPUT D | OUTPUTS | | Bus state |
|---|---|---|---|
| | CANH | CANL | |
| L | H | L | Dominant |
| H | Z | Z | Recessive |
| X | Z | Z | Recessive |

(1) H=high level; L=low level; Z=high impedance

Table 2. Receiver functions

| $V_{ID}$=CANH-CANL | $R_S$ | OUTPUT R |
|---|---|---|
| $V_{ID}$≥0.9V | X | L |
| 0.5< $V_{ID}$<0.9V | X | ? |
| $V_{ID}$≤0.5V | X | H |
| Open | X | H |

(1) H=high level; L=low level; ?=uncertain; X=irrelevant

## TEST CIRCUIT

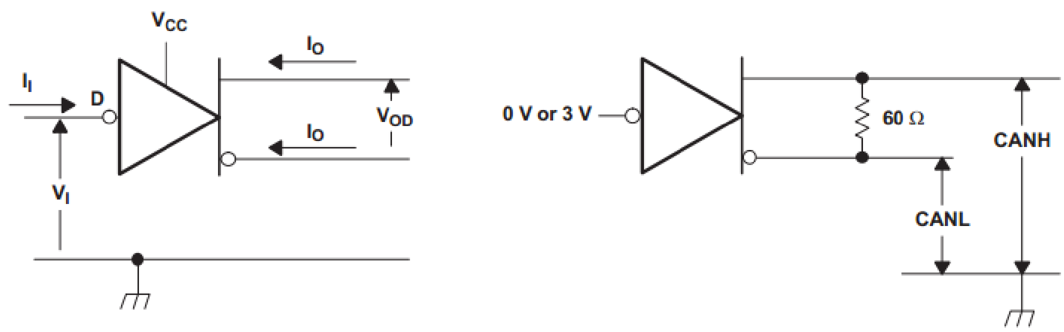



**Fig.1 Driver Voltage And Current Definition**

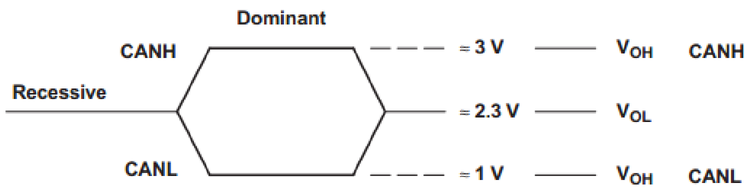



**Fig.2 Bus Logic State Voltage Definition**

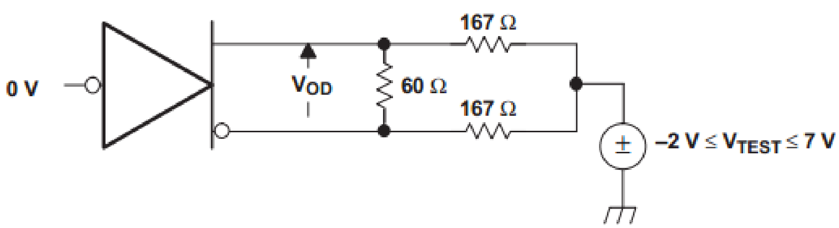
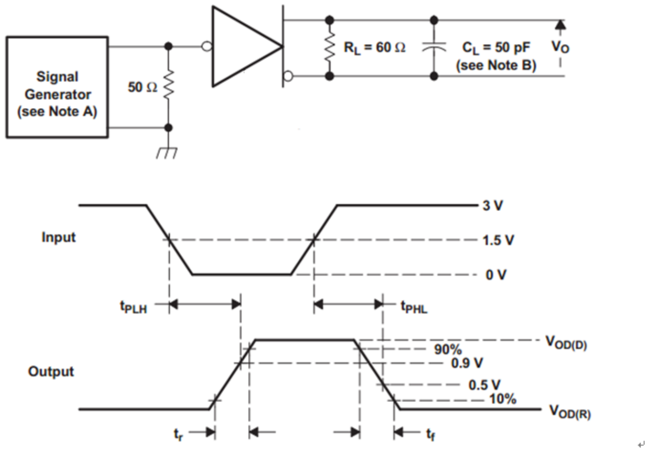



**Fig.3 Driver $V_{OD}$ Test Circuit**




A. The input pulse is supplied by a generator having the following characteristics

PRR ≤ 500 kHz, 50% duty cycle, tr < 6 ns, tf < 6 ns, Zo=50Ω

B. CL includes instrumentation and fixture capacitance within ±20%.

**Fig.4 Driver Test Circuit and Waveform**

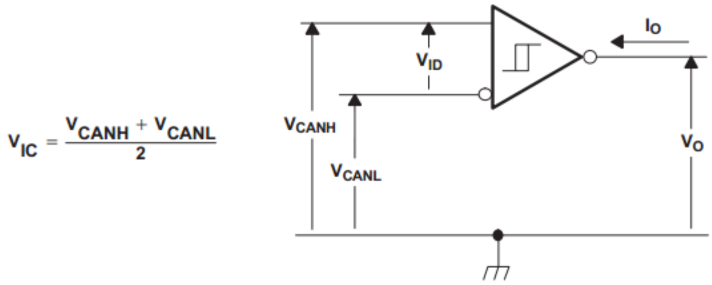
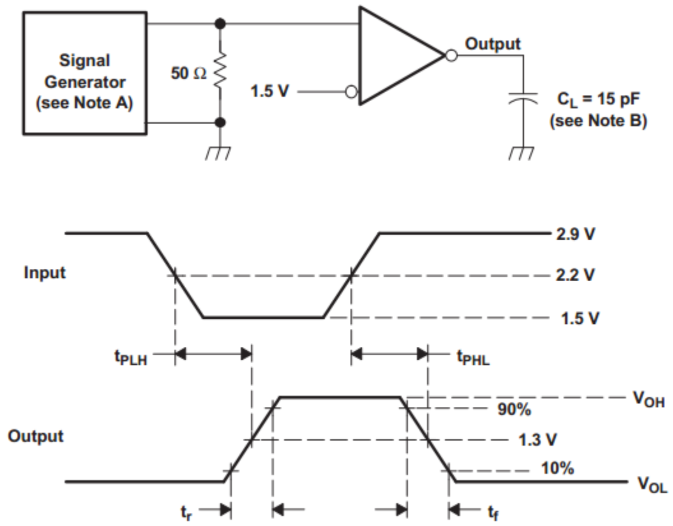



**Fig.5 Receiver Voltage and Current Definition**

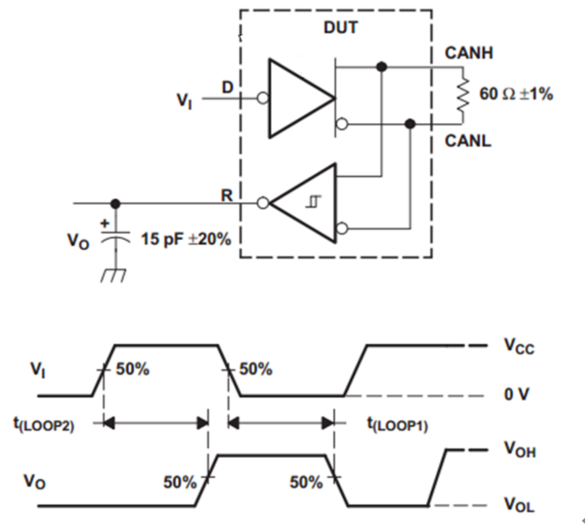



A. The input pulse is supplied by a generator having the following characteristics

PRR ≤ 500 kHz, 50% duty cycle, tr < 6 ns, tf < 6 ns, Zo=50Ω

B. CL includes instrumentation and fixture capacitance within ±20%.

**Fig.6 Receiver Test Circuit and Waveform**




A. The input pulse is supplied by a generator having the following characteristics

PRR ≤ 500 kHz, 50% duty cycle, tr < 6 ns, tf < 6 ns, Zo=50Ω

**Fig.7 $t_{(LOOP)}$ Test Circuit and Waveform**

## DESCRIPTION

### 1 Brief description

The SIT65HVD232 is the interface between the Controller Area Network (CAN) protocol controller and the physical bus. It is designed for use with the 3.3V µPs, MCUs and DSPs with CAN controllers, or with equivalent protocol controller devices. It is used in industrial automation, control, sensors and drive systems, motor and robotic control, building and climate control (HVAC), telecom and basestation control and status. The devices are designed for data rates up to 1 Mbps, and are intended for use in applications employing the CAN serial communication physical layer in accordance with the ISO 11898 standard.

### 2 Short-circuit protection

A current-limiting circuit protects the driver output stage of the SIT65HVD232 against short-circuits to positive and negative supply voltage. When short-circuit occurs the power dissipation increases but the short-circuit protection function will prevent destruction of the driver output stage.

### 3 Over-temperature protection

The SIT65HVD232 has an integrated over-temperature protection circuit. If the junction temperature exceeds approximately 160°C, the current in the driver stage will decrease. Because the driver stage dissipates most of the power, the power dissipation and temperature of the IC is reduced. All other parts of the chip remain operational.

### 4 Electrical transient protection

Electrical transients often occur in automotive applications. The CANH and CANL of the SIT65HVD232 are also protected against electrical transients.

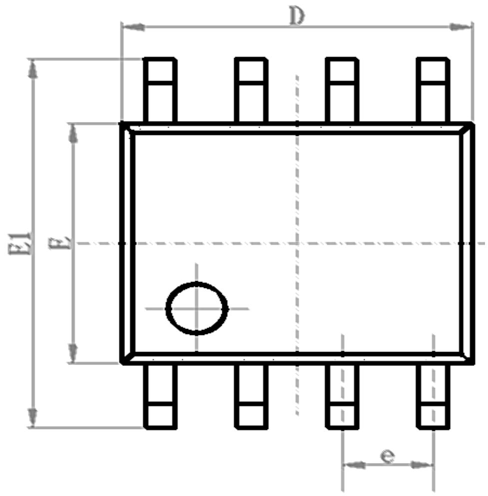
### 5 Control mode

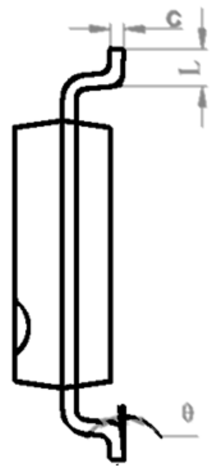
The SIT65HVD232 provides a default operation mode: high-speed mode.
The high-speed mode of operation is commonly employed in industrial applications. High-speed allows the output to switch as fast as possible with no internal limitation on the output rise and fall slopes.

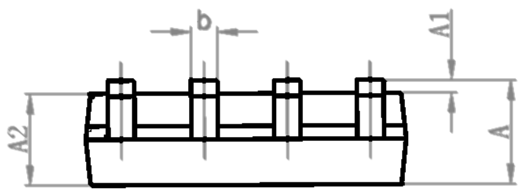
## SOP8 DIMENSIONS

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° |



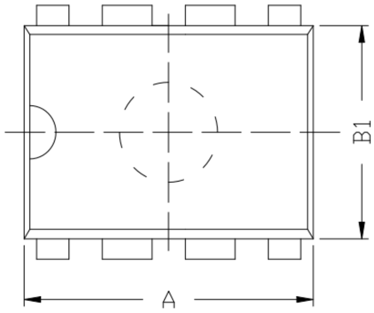



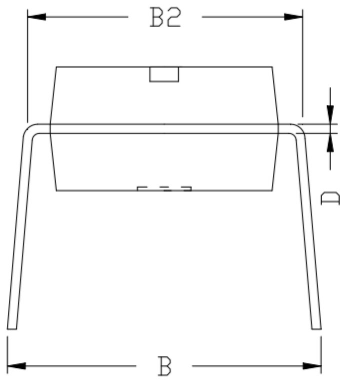



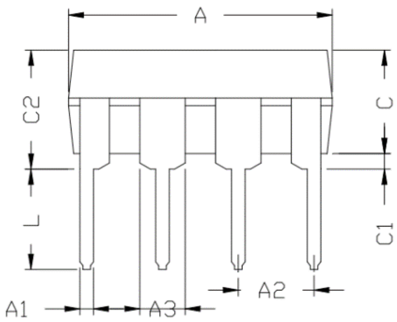
## DIP8 DIMENSIONS

**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 |
|---|---|---|
| SIT65HVD232DR | -40℃~125℃ | SOP8 |
| SIT65HVD232P | -40℃~125℃ | DIP8 |

Tape/reel package is 2500 pieces