## characteristic:

- Powered by a single 3.3V power supply;
- Comply with ISO 11898-2 standard;
- Total lead ESD protection exceeds ±12kV human model (HBM);
- Up to 120 nodes can be connected on a single bus;
- The adjustable driver conversion time can improve the radiation performance;
- Low current standby mode: 360μA (typical value);
- Designed for data rates up to 1Mbps;
- Hot shutdown protection;
- Open circuit fault safety design;
- Non-scratch pulse power on and off protection for hot-swappable applications

## Product appearance:

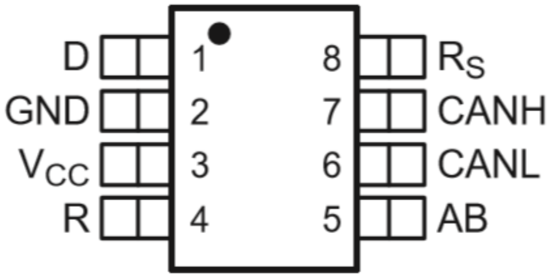

Provide green and lead-free packaging

## description

SIT65HVD235 is an interface chip used between CAN protocol controllers and physical buses. It works with 3.3V microprocessors, microcontrollers (MCUs), and digital signal processors (DSPs) or equivalent protocol controllers equipped with CAN controllers. It is applied in industrial automation, control, sensor and drive systems, motor and robot control, building and temperature control, telecommunications and base station control, as well as status monitoring. It is suitable for applications that use the CAN serial communication physical layer in compliance with ISO 11898 standards.

| Parameter | Symbol | Test condition | Minimum | Maximum | Unit |
|---|---|---|---|---|---|
| Service voltage | $V_{cc}$ | | 3 | 3.6 | V |
| Peak transfer rate | $1/t_{bit}$ | Non-zero code | 1 | | Mbaud |
| CANH、CANL Input and output voltage | $V_{can}$ | | -36 | +36 | V |
| Total line differential voltage | $V_{diff}$ | | 1.5 | 3.0 | V |
| Ambient temperature | $T_{amb}$ | | -40 | 125 | ℃ |

## Pin distribution diagram


D
GND
VCC
R
1
2
3
4
8
7
6
5
RS
CANH
CANL
AB

## absolute rating

| Parameter | Symbol | Big or small | Unit |
|---|---|---|---|
| Supply voltage | $V_{CC}$ | -0.3~+6 | V |
| MCU side port voltage | D，R | -0.5~VCC+0.5 | V |
| Total input voltage on the bus | CANL，CANH | -36~36 | V |
| 6, Transient voltage at pin 7 | $V_{tr}$ | -100~+100 | V |
| Receiver output current, IO | | -11~11 | mA |
| Storage working temperature range | | -40~150 | ℃ |
| Ambient temperature | | -40~125 | ℃ |
| Welding temperature range | | 300 | ℃ |
| Continuous power consumption | SOP8 | 400 | mW |
| | DIP8 | 700 | mW |

The maximum limit parameter value is the value beyond which the device may suffer irreversible damage. Under these conditions, it is not conducive to the normal operation of the device. Continuous operation of the device at the maximum allowable rating may affect the reliability of the device. All voltage reference points are ground.

## Pin definition

| Pin number | Pin name | Pin function |
|---|---|---|
| 1 | D | CAN sends data input (low level in explicit bus state; high level in implicit bus state), also known as TXD, driver input |
| 2 | GND | Grounding connection |
| 3 | VCC | Transceiver 3.3V, power supply voltage |
| 4 | R | The CAN receives data output (low level in the explicit bus state; high level in the implicit bus state), also known as RXD, driver output |
| 5 | AB | The automatic baud rate loopback mode inputs control pins |
| 6 | CANL | Low level CAN bus |
| 7 | CANH | High level CAN bus |
| 8 | $R_S$ | Mode selection pin: Strong pull-down to GND= high speed mode; strong pull-up to VCC = low power mode; through 10 kΩ to 100kΩ, resistor pull-down to GND = slope control |

| | | |
|---|---|---|
| | | mode. |

## DC characteristics of the total signal transmitter

| Symbol | Parameter | | Test condition | Minimum | Typical case | Maximum | Unit |
|---|---|---|---|---|---|---|---|
| $V_{O(D)}$ | Output voltage (dominance) | CANH | VI = 0V, RS = 0V, RL = 60Ω (see Figure 1 and Figure 2) | 2.45 | | VCC | V |
| | | CANL | | 0.5 | | 1.25 | |
| $V_{OD(D)}$ | Differential output voltage (explicit) | | VI = 0V, RS = 0V, RL = 60Ω (see Figure 1) | 1.5 | 2 | 3 | V |
| | | | VI=0V, RL=60Ω, RS =0V (see Figure 3) | 1.2 | 2 | 3 | V |
| $V_{O(R)}$ | Output voltage (covert gender) | CANH | VI = 3V, RS = 0V, RL = 60Ω (see Figure 1) | | 2.3 | | V |
| | | CANL | | | 2.3 | | |
| $V_{OD(R)}$ | Differential output voltage (hidden) | | VI=3V, $R_S$=0V | -0.12 | | 0.012 | V |
| | | | VI=3V, $R_S$=0V,NO LOAD | -0.5 | | 0.05 | V |
| $I_{IH}$ | High voltage input current | | VI=2V | -30 | | 30 | μA |
| $I_{IL}$ | Low voltage input current | | VI=0.8V | -30 | | 30 | μA |
| $I_{OS}$ | Short circuit output current | | CANH=-7V | -250 | | | mA |
| | | | CANH=12V | | | 1 | |
| | | | CANL=-7V | -1 | | | |
| | | | CANL=12V | | | 250 | |
| $C_O$ | Output capacitance | | See receiver | | | | |
| $I_{CC}$ | Supply current | | Await the opportune moment | | 360 | 600 | μA |
| | | | VI=0V (dominant), no load | | | 6 | mA |
| | | | VI=VCC (heterozygous), no load | | | 6 | mA |

(If not otherwise stated, VCC=3.3V±10%, Temp=TMIN~TMAX, typical value in VCC=+3.3V, Temp = 25 )

| Symbol | Parameter | Test condition | Minimum | Typical case | Maximum | Unit |
|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation delay (low to high) | R = 0, i.e. short circuit (see Figure 4) | | 35 | 85 | ns |
| | | R=10 kΩ | | 70 | 125 | |
| | | R=100 kΩ | | 500 | 870 | |
| $t_{PHL}$ | Propagation delay (high to low) | R = 0, i.e. short circuit (see Figure 4) | | 70 | 120 | |
| | | R=10 kΩ | | 130 | 180 | |
| | | R=100 kΩ | | 870 | 1200 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| $t_{sk(p)}$ | Propagation delay symmetry (\| $t_{PLH}$ - $t_{PHL}$ \|) | R = 0, i.e. short circuit (see Figure 4) | | 35 | | |
| | | R=10 kΩ | | 60 | | |
| | | R=100 kΩ | | 370 | | |
| tr | Differential output rise time | R = 0, i.e. short circuit (see Figure 4) | 20 | | 80 | |
| | | R=10 kΩ | 30 | | 160 | |
| | | R=100 kΩ | 300 | | 1400 | |
| tf | Differential output fall time | R = 0, i.e. short circuit (see Figure 4) | 20 | | 80 | |
| | | R=10 kΩ | 30 | | 160 | |
| | | R=100 kΩ | 300 | | 1400 | |

(If not otherwise stated, VCC=3.3V±10%, Temp=TMIN~TMAX, typical value in VCC=+3.3V, Temp = 25 )

## DC characteristics of the total signal receiver

| Symbol | Parameter | Test condition | Minimum | Typical case | Maximum | Unit |
|---|---|---|---|---|---|---|
| $V_{IT+}$ | Receiver is at threshold | See Table 1 | | 750 | 900 | mV |
| $V_{IT-}$ | Receiver negative threshold | See Table 1 | 500 | 650 | | mV |
| $V_{hys}$ | The lag range | VIT+- VIT- | | 100 | | mV |
| $V_{OH}$ | High level output voltage | -6V<VID<500mV Io =-8mA (see Figure 5) | 2.4 | | | V |
| $V_{OL}$ | Low level output voltage | 900mV<VID<6V Io =8 mA (see Figure 5) | | | 0.4 | V |
| $I_i$ | Total input current for the bus | VIH=12V，VCC=0V | 100 | | 600 | uA |
| $I_i$ | | VIH=12V，VCC=3.3V | 100 | | 500 | μA |
| $I_i$ | | VIH=-7V，VCC=0V | -450 | | -20 | μA |
| $I_i$ | | VIH=-7V，VCC=3.3V | -610 | | -30 | μA |
| $R_i$ | Total input resistance of the bus | ISO 11898-2 corresponding standard | 20 | 35 | 50 | KΩ |
| $R_{diff}$ | Differential input resistance | ISO 11898-2 corresponding standard | 40 | | 100 | KΩ |
| | Total input ca- | ISO 11898-2 corre- | | 40 | | pF |

| | | | | | | |
|---|---|---|---|---|---|---|
| $C_i$ | pacitance of the bus | sponding standard | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| $C_{diff}$ | Differential-input capacitance | ISO 11898-2 corresponding standard | | 20 | | pF |
| $I_{CC}$ | Supply current | See the driver | | | | |

(If not otherwise stated, VCC=3.3V±10%, Temp=TMIN~TMAX, typical value in VCC=+3.3V, Temp = 25 )

## Total line receiver switch characteristics

| Symbol | Parameter | Test condition | Minimum | Typical case | Maximum | Unit |
|---|---|---|---|---|---|---|
| $t_{PLH}$ | Receiver propagation delay (low-high) | See Figure 6 | | 35 | 60 | ns |
| $t_{PHL}$ | Receiver propagation delay (high-low) | See Figure 6 | | 35 | 60 | ns |
| $t_{sk}$ | Pulse shift | $\|t_{PHL} - t_{PLH}\|$ | | | 10 | ns |
| $t_r$ | Output signal rise time | See Figure 6 | | 1.5 | | ns |
| $t_f$ | Output signal fall time | See Figure 6 | | 1.5 | | ns |

(If not otherwise stated, VCC=3.3V±10%, Temp=TMIN~TMAX, typical value in VCC=+3.3V, Temp = 25 )

## Device switch characteristics

| Symbol | Parameter | Test condition | Minimum | Typical case | Maximum | Unit |
|---|---|---|---|---|---|---|
| $t_{(LOOP1)}$ | Loop delay 1, driver input to receiver output, implicit to explicit | R=0, i.e. short circuit (see Figure 8) | | 70 | 135 | ns |
| | | R=10 kΩ | | 105 | 190 | ns |
| | | R=100 kΩ | | 535 | 1000 | ns |
| $t_{(LOOP2)}$ | Loop delay 2, driver input to receiver output, explicit to implicit | R = 0, i.e. short circuit (see Figure 8) | | 70 | 165 | ns |
| | | R=10 kΩ | | 105 | 190 | ns |
| | | R=100 kΩ | | 535 | 1000 | ns |
| | The loopback | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| $t_{(AB1)}$ | delay drives the input of the driver to the output of the receiver | (See figure 9) | | 10 | 20 | ns |
| $t_{(AB2)}$ | The loopback delay drives the input of the receiver to the output | (See figure 10) | | 35 | 60 | ns |

(If not otherwise stated, VCC=3.3V±10%, Temp=TMIN~TMAX, typical value in VCC=+3.3V, Temp = 25 )

## Over temperature protection

| Symbol | Parameter | Test condition | Minimum | Typical case | Maximum | Unit |
|---|---|---|---|---|---|---|
| Overtemperature shutdown | Tj(sd) | | 155 | 165 | 180 | ℃ |

(If not otherwise stated, VCC=3.3V±10%, Temp=TMIN~TMAX, typical value in VCC=+3.3V, Temp = 25 )

## Control pin characteristics

| Symbol | Parameter | Test condition | Minimum | Typical case | Maximum | Unit |
|---|---|---|---|---|---|---|
| $T_{WAKE}$ | Wait until the wake time | RS Joining square wave (see Figure 7) | | 0.55 | 1.5 | μs |
| $I_{RS}$ | High speed mode input current | $V_{RS}$<1V | -450 | | 0 | μA |
| $V_{RS}$ | Standby/sleep input voltage | 0<$V_{RS}$<$V_{CC}$ | 0.75$V_{CC}$ | | $V_{CC}$ | V |
| $I_{off}$ | Dropping leakage current | Vcc=0V , $V_{CANH}$=$V_{CANL}$=5V | -250 | | 250 | μA |

(If not otherwise stated, VCC=3.3V±10%, Temp=TMIN~TMAX, typical value in VCC=+3.3V, Temp = 25 )

## supply current

| Parameter | Symbol | Test condition | Minimum | Typical case | Maximum | Unit |
|---|---|---|---|---|---|---|
| Standby power consumption | $I_{CC}$ | $R_S$=VCC, $V_I$=VCC | | 360 | 600 | μA |
| Visible power consumption | | $V_I$=0V, $R_S$=0V, LOAD=60Ω | | 50 | 70 | mA |
| Hidden power consumption | | $V_I$=VCC, $R_S$=0V, NO LOAD | | | 6 | mA |

(If not otherwise stated, VCC=3.3V±10%, Temp=TMIN~TMAX, typical value in VCC=+3.3V, Temp = 25 )

## Function table

Table 1 Receiver characteristics in common mode mode (V(RS)=1.2V)

| $V_{ID}$ | $V_{CANH}$ | $V_{CANL}$ | R OUTPUT | |
|---|---|---|---|---|
| 900mV | -6.1V | -7V | L | VOL |
| 900mV | 12V | 11.1V | L | |
| 6V | -1V | -7V | L | |
| 6V | 12V | 6V | L | |
| 500mV | -6.5V | -7V | H | VOH |
| 500mV | 12V | 11.5V | H | |
| -6V | -7V | -1V | H | |
| -6V | 6V | 12V | H | |
| X | Open | Open | H | |

(1) H= high level; L= low level; X= not related

Table 2 Driver functions

| INPUTS | | | OUTPUTS | | |
|---|---|---|---|---|---|
| **D** | **LBK** | **$R_S$** | **CANH** | **CANL** | **General vehicle status** |
| X | X | >0.75$V_{CC}$ | Z | Z | Covert gender |
| L | L or open | <0.33$V_{CC}$ | H | L | Dominance |
| H or open | X | <0.33$V_{CC}$ | Z | Z | Covert gender |
| X | H | 0.33$V_{CC}$ | Z | Z | Covert gender |

(1) H= high level; L= low level; Z= high resistance state

Table 3 Receiver functions

| INPUTS | | | | OUTPUT |
|---|---|---|---|---|
| **General vehicle status** | **$V_{ID}$=CANH-CANL** | **LBK** | **D** | **R** |
| Dominance | $V_{ID}\geq0.9V$ | L or open | X | L |
| Covert gender | $V_{ID}\leq0.5V$ or open | L or open | H or open | H |
| ? | $0.5< V_{ID}<0.9V$ | L or open | H or open | ? |
| Dominance | $V_{ID}\geq0.9V$ | H | X | L |
| Covert gender | $V_{ID}\leq0.5V$ or open | H | H | H |
| Covert gender | $V_{ID}\leq0.5V$ or open | H | L | L |
| ? | $0.5< V_{ID}<0.9V$ | H | L | L |

(2) H= high level; L= low level;? = uncertain; X= not related

## test circuit

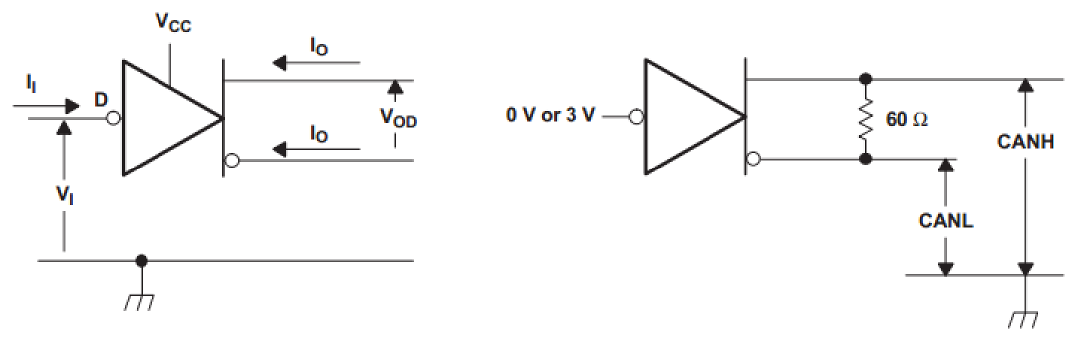



Figure 1 Definition of driver voltage and current test

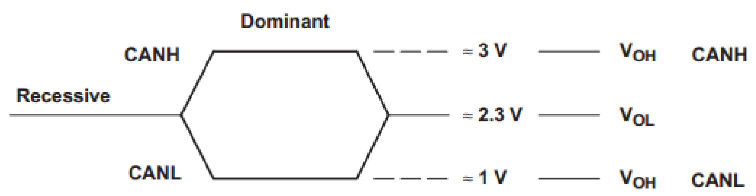



Figure 2 Bus logic voltage definition

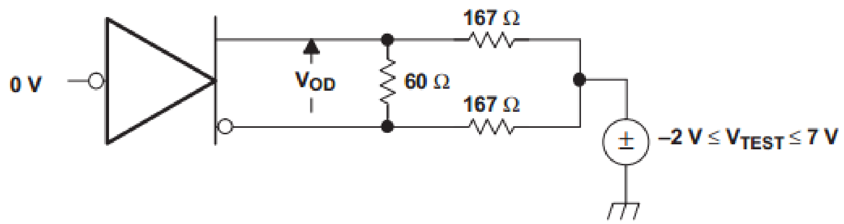
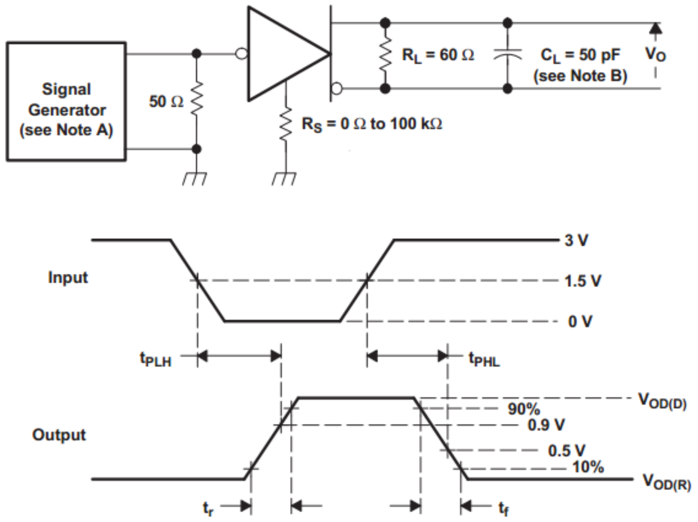



Figure 3 Driver VOD test circuit




A. Characteristics of input pulse generator: PRR is less than or equal to 500KHz, duty cycle is 50%, tr is less than 6ns, tf is less than 6ns, Zo is 50Ω

B and CL include instruments and fixed capacitors with an error of less than 20%.

Figure 4 Driver test circuit and voltage waveform

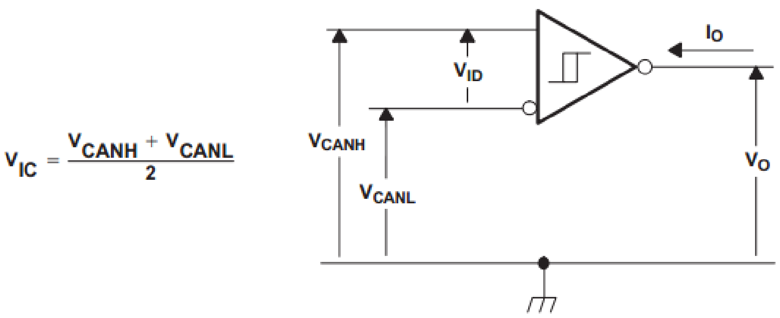
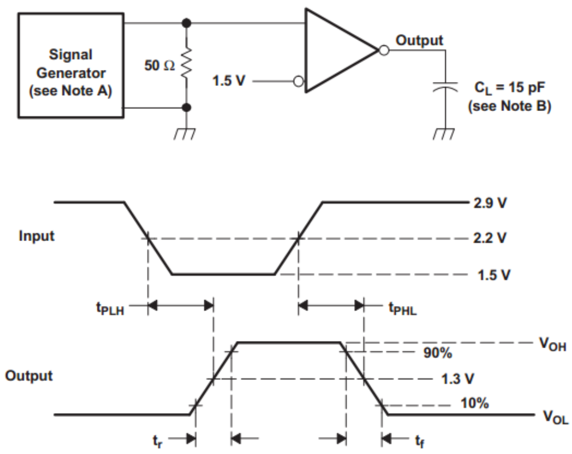



Figure 5 Receiver voltage and current definition




A. Characteristics of input pulse generator: PRR is less than or equal to 500KHz, duty cycle is 50%, tr is less than 6ns, tf is less than 6ns, Zo is 50Ω

B and CL include instruments and fixed capacitors with an error of less than 20%.

Figure 6 Receiver test circuit and voltage waveform

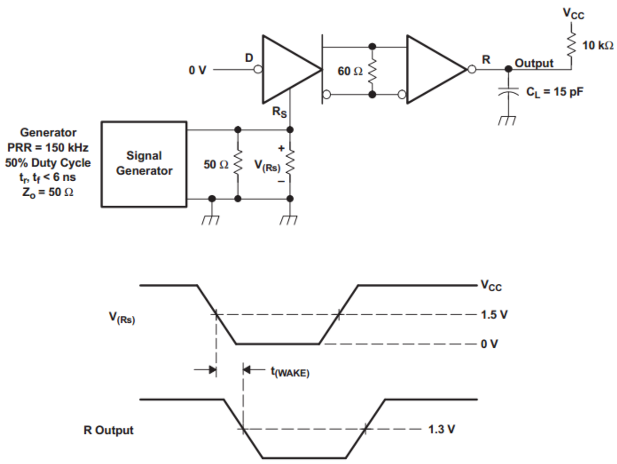
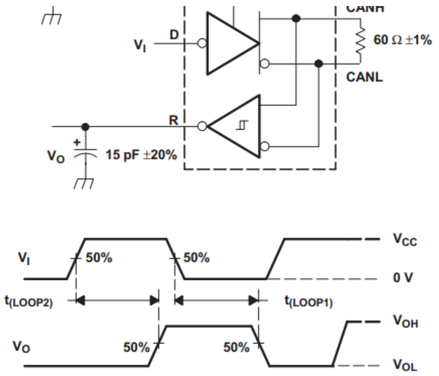
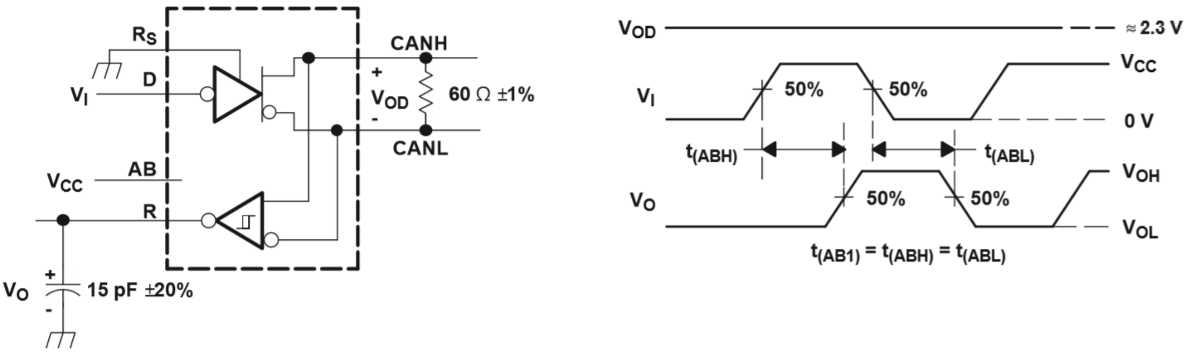



Figure 7 t (WAKE) test circuit and voltage waveform



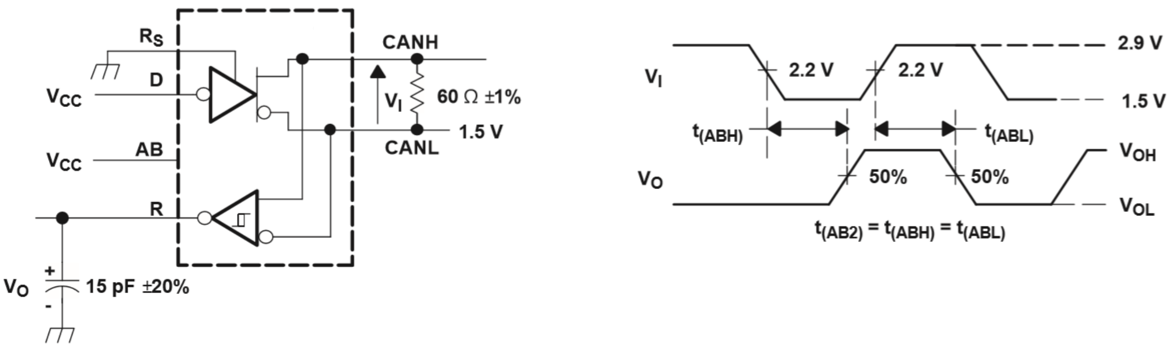

A. Characteristics of input pulse generator: PRR is less than or equal to 125KHz, 50% duty cycle, tr <6ns, tf <6ns, Zo = 50Ω

Figure 8 t (LOOP) test circuit and voltage waveform




:f <6ns

Figure 9 t (AB1) test circuit and voltage waveform




, tf <6ns

Figure 10 t (AB2) test circuit and voltage waveform explain

## 1 resume

SIT65HVD235 is an interface chip used between CAN protocol controllers and physical buses. When combined with 3.3V microprocessors, microcontrollers (MCUs), and digital signal processors (DSPs) or equivalent protocol controllers equipped with CAN controllers, it can be applied in industrial automation, control, sensor and drive systems, motor and robot control, building and temperature control, telecommunications and base station control, as well as status monitoring. It supports speeds up to 1Mbps and is fully compatible with the "ISO 11898" standard.

## 2 short-circuit protection

The drive level of SIT65HVD235 has a current limiting protection function to prevent the drive circuit from short-circuiting to the positive and negative power supply voltage. When a short circuit occurs, the power consumption will increase. The short circuit protection function can protect the drive level from damage.

## 3 Over temperature protection

SIT65HVD235 It has overtemperature protection function. When the junction temperature exceeds 160℃, the current of the driver level will be reduced, because the driver tube is the main energy consuming component, and the current reduction can reduce power consumption and thus reduce the chip temperature. At the same time, other parts of the chip still maintain normal operation.

## 4 Electrical transient protection

Electrical transients often occur in automotive applications, and SIT65HVD235's CANH and CANL have the function of preventing electrical transients from damaging.

## 5 control model

Three different operating modes are provided by the RS pin (pin 8): high speed mode, slope control mode and low power mode.

(1) High speed mode:

Applying a logic low level to the RS pin (pin 8) selects high-speed mode. High-speed operation is typically used in industrial applications. High-speed mode allows for output switching at the fastest possible rate and imposes no internal limits on the rise and fall times of the output. If high-speed transitions affect radiation performance, a slope control mode can be used.

If the application requires both high-speed and low-power standby modes, the mode selection pin can be directly connected to a general-purpose output pin of the microprocessor, MCU, or DSP. When the controller outputs a logic low level (<1.2 V), the device enters high-speed mode; when the controller outputs a logic high level (> 0.75 VCC), the device enters standby mode.

(2) Slope control mode

For many applications that still use unshielded twisted pair bus cables to reduce system costs, electromagnetic compatibility is critical. The device has added a slope control mode, which can reduce the electromagnetic interference caused by the rise and fall times of the driver and the harmonics generated as a result. By connecting a resistor between RS (pin 8) and ground or logic low voltage, the rise and fall slopes of the driver output can be adjusted. The slope of the driver output signal is proportional to the output current of the pin, and this slope control is achieved through an external resistor (typically 10k Ω to 100kΩ).

(3) standby mode

If a logic high level (> 0.75 VCC) is applied to the RS (pin 8), the device circuit will enter low current, listen-only standby mode. During this mode, the driver will be turned off, and the receiver will remain active. In this listen-only state, the transceiver is completely passive with respect to the bus. There will be no difference whether or not a slew control resistor is placed. When a rising edge of an active state (bus differential voltage> 900mV (typical value)) appears on the bus, the microprocessor can put the transceiver out of this low-power standby mode. Microprocessor

The device senses bus activity and reactivates the driver circuit by applying a logic low level (<1.2V) to RS (pin 8).

## 6 Automatic baud rate loopback function

The SIT65HVD235 can be set to high level through input pin 5 (AB) to enter the automatic baud rate loopback mode. In this mode, the driver output is disabled, blocking the transmission path from pin D to the bus and the bus's transmission function, with the bus pins being set to inactive. The transmission path from the receiver to pin R remains normal or the bus maintains a receive state, allowing bus activity to be monitored. Additionally, the automatic baud rate loopback mode adds an internal logic loopback path from pin D to pin R, enabling local nodes to transmit synchronously without interfering with information on the bus. Therefore, if the CAN controller of a local node generates an error frame, it will not be transmitted to the bus but will only be detected by the local CAN controller. This is particularly helpful for determining whether the local node is set to the same baud rate as the network and whether it has been adjusted to the network baud rate. Automatic baud rate detection is most suitable for applications with known selected baud rates. For example, popular communication frequencies in industrial equipment include 125kbps, 250kbps, or 500kbps. Once the SIT65HVD235 enters automatic baud rate loopback mode, the first baud rate that the application software can handle is 125kbps. It then waits for another node on the bus to transmit information. If an incorrect baud rate is chosen, the local CAN controller will generate an error message due to the incorrect sampling time of the information. However, since the bus transmission function has been disabled, no other node will receive the error frame generated by the CAN controller of this node.

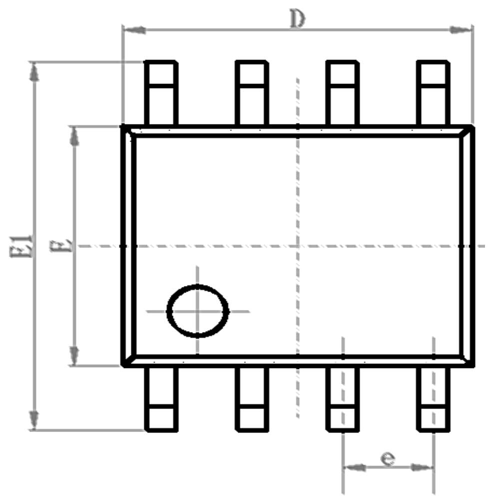
Then, the application will use the status register of the local CAN controller to determine the received message and error warning status, to confirm whether the set baud rate is correct. The warning status indicates that the error count of the CAN controller has been incremented. The received message status indicates that a valid message has been received. If an error occurs, the application will set the CAN controller to the next possible valid baud rate and then wait for another message. This process is repeated until a correct message is received. Therefore, the correct baud rate has been selected. At this point, the application sets pin 5 of the SIT65HVD235 to a low level, putting the SIT65HVD235 into normal receive mode, thus enabling the bus transmission and reception functions of the transceiver to operate normally.

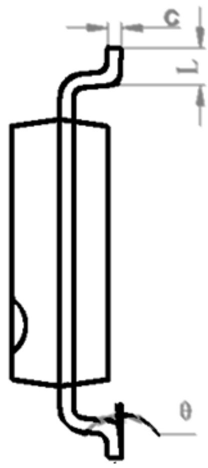
If the AB pin is not used, it can be grounded (GND) or left open (open), because in the open state the chip will pull down the pin internally (default low level input).

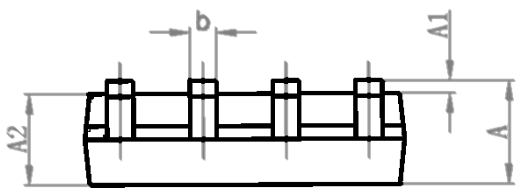
## SOP8, external dimensions

Package size

| Symbol | Least value /mm | Representative value /mm | Crest value /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° |



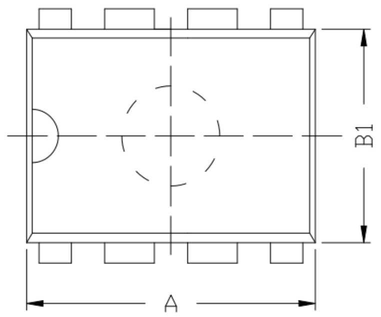



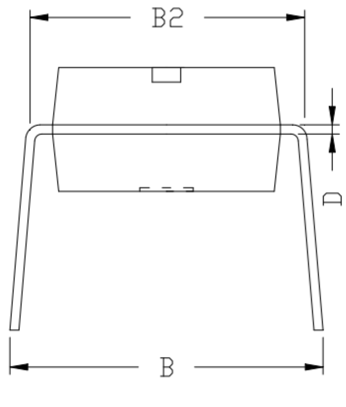



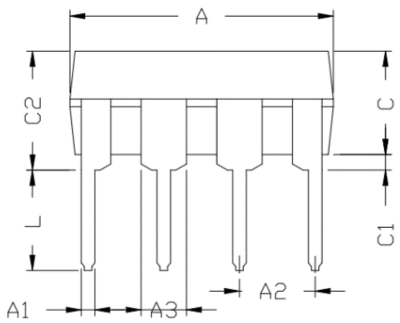
## DIP8, external dimensions

Package size

| Symbol | Least value /mm | Representative value /mm | Crest value /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 |




## Order information

| Order code | Temperature | Package |
|---|---|---|
| SIT65HVD235DR | -40℃~125℃ | SOP8 |
| SIT65HVD235P | -40℃~125℃ | DIP8 |

The tape packaging is 2500 beads per disc