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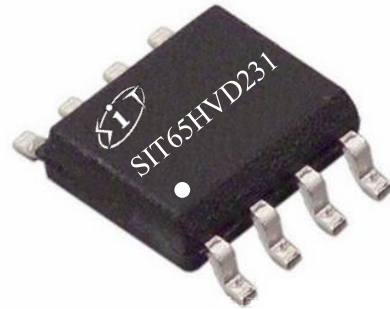
3.3V power supply, high electrostatic protection, ultra-low  
sleep power consumption, 1Mbps high-speed CAN bus transceiver

SIT65HVD231

### characteristic:

- Powered by a single power supply of 3.3V;
- Comply with ISO 11898-2 standard;
- Total lead ESD protection exceeds  $\pm 16\text{kV}$  human model (HBM);
- Up to 120 nodes can be connected on a single bus;
- The adjustable driver conversion time can improve the radiation performance;
- Ultra-low current sleep mode: 40nA (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 shape:

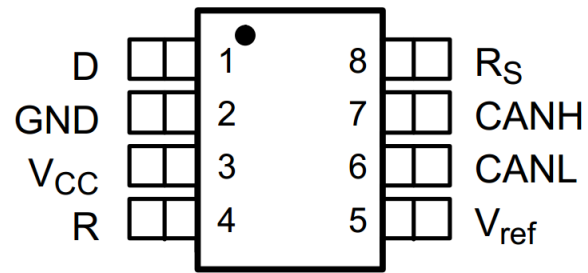


Provide green and lead-free packaging

### description

SIT65HVD231 is an interface chip used between CAN protocol controllers and physical buses, featuring low-current sleep mode. It can be combined with 3.3V microprocessors, microcontrollers (MCUs), and digital signal processors (DSPs) or equivalent protocol controllers equipped with CAN controllers. This chip 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 compliant 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	$V_{can}$		-16	+16	V
Total line differential voltage	$V_{diff}$		1.5	3.0	V
Ambient temperature	$T_{amb}$		-40	125	°C





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absolute rating

Parameter	Symbol	Big or small	Unit
Supply voltage	$V_{CC}$	-0.3~+6	V
MCU side port voltage	D, R	-0.5~ $V_{CC}+0.5$	V
Total input voltage on the bus	CANL, CANH	-18~18	V
6, 7 pin transient voltage	$V_{tr}$	-25~+25	V
Receiver output current, IO		-11~11	mA
Storage working temperature range		-40~150	°C
Ambient temperature		-40~125	°C
Welding temperature range		300	°C
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, the device is not operating properly and continuous operation 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	Vref	$V_{cc}/2$ is the reference output pin
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 sleep mode; through 10k to 100k , 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	$V_I = 0V, R_S = 0V, R_L = 60 \Omega$ (see Figure 1 and Figure 2)	2.45		VCC	V
		CANL		0.5		1.25	
$V_{OD(D)}$	Differential output voltage (explicit)		$V_I = 0V, R_S = 0V, R_L = 60 \Omega$ (see Figure 1)	1.5	2	3	V
			$V_I = 0V, R_L = 60 \Omega, R_S = 0V$ (see Figure 3)	1.2	2	3	V
$V_{O(R)}$	Output voltage (covert gender)	CANH	$V_I = 3V, R_S = 0V, R_L = 60 \Omega$ (see Figure 1)		2.3		V
		CANL			2.3		
$V_{OD(R)}$	Differential output voltage (hidden)		$V_I = 3V, R_S = 0V$	-0.12		0.012	V
			$V_I = 3V, R_S = 0V, \text{NO LOAD}$	-0.5		0.05	V
$I_{IH}$	High voltage input current		$V_I = 2V$	-30			$\mu A$
$I_{IL}$	Low voltage input current		$V_I = 0.8V$	-30			$\mu A$
$I_{OS}$	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		Dormancy		0.04	1	$\mu A$
			$V_I = 0V$ (dominant), no load		10	17	mA
			$V_I = V_{CC}$ (heterozygous), no load		10	17	mA

(If not otherwise stated,  $V_{CC} = 3.3V \pm 10\%$ ,  $Temp = T_{MIN} \sim T_{MAX}$ , typical value in  $V_{CC} = +3.3V$ ,  $Temp = 25^\circ C$ )

Symbol	Parameter	Test condition	Minimum	Typical case	Maximum	Unit
<b>t<sub>PLH</sub></b>	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	
<b>t<sub>PHL</sub></b>	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	
<b>t<sub>sk(p)</sub></b>	Propagation delay symmetry	R=0, i.e. short circuit (see Figure 4)		35		



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	$( t_{PLH} - t_{PHL} )$	R=10 k $\Omega$		60	
		R=100 k $\Omega$		370	
<b>tr</b>	Differential out-put rise time	R=0, i.e. short circuit (see Figure 4)	25	50	100
		R=10 k $\Omega$	80	120	160
		R=100 k $\Omega$	600	800	1200
<b>tf</b>	Differential out-put fall time	R = 0, i.e. short circuit (see Figure 4)	40	55	80
		R=10 k $\Omega$	80	125	150
		R=100 k $\Omega$	600	825	1000

(If not otherwise stated, VCC=3.3V $\pm$ 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
<b>V<sub>IT+</sub></b>	Receiver is at threshold	See Table 1		750	900	mV
<b>V<sub>IT-</sub></b>	Receiver negative threshold	See Table 1	500	650		mV
<b>V<sub>hys</sub></b>	The lag range	V <sub>IT+</sub> - V <sub>IT-</sub>		100		mV
<b>V<sub>OH</sub></b>	High level output voltage	-6V<V <sub>ID</sub> <500mV I <sub>o</sub> = -8mA (see Figure 5)	2.4			V
<b>V<sub>OL</sub></b>	Low level output voltage	900mV<V <sub>ID</sub> <6V I <sub>o</sub> = 8mA (see Figure 5)			0.4	V
<b>I<sub>i</sub></b>	Total input current for the bus	V <sub>IH</sub> =7V, VCC=0V	100		350	$\mu$ A
<b>I<sub>i</sub></b>		V <sub>IH</sub> =7V, VCC=3.3V	100		250	$\mu$ A
<b>I<sub>i</sub></b>		V <sub>IH</sub> =-2V, VCC=0V	-100		-20	$\mu$ A
<b>I<sub>i</sub></b>		V <sub>IH</sub> =-2V, VCC=3.3V	-200		-30	$\mu$ A
<b>R<sub>i</sub></b>	Total input resistance of the bus	ISO 11898-2 corresponding standard	20	35	50	K $\Omega$
<b>R<sub>diff</sub></b>	Differential input resistance	ISO 11898-2 corresponding standard	40		100	K $\Omega$
<b>C<sub>i</sub></b>	Total input capacitance of the bus	ISO 11898-2 corresponding standard		40		pF

$C_{diff}$	Differential - input capacita- nce	ISO 11898-2 corre- sponding standard		20		pF
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<b>I<sub>CC</sub></b>	Supply current	See the driver				
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(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
<b>t<sub>PLH</sub></b>	Receiver transmission delay (low-high)	See Figure 6		35	50	ns
<b>t<sub>PHL</sub></b>	Receiver transmission delay (high-low)	See Figure 6		35	50	ns
<b>t<sub>sk</sub></b>	Pulse shift	t <sub>PHL</sub> - t <sub>PLH</sub>			10	ns
<b>t<sub>r</sub></b>	Output signal rise time	See Figure 6		1.5		ns
<b>t<sub>f</sub></b>	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
<b>t<sub>(LOOP1)</sub></b>	Loop delay 1, driver input to receiver output, implicit to explicit	R = 0, i.e. short circuit (see Figure 8)		70	115	ns
		R=10 kΩ		105	175	
		R=100 kΩ		535	920	
<b>t<sub>(LOOP2)</sub></b>	Loop delay 2, driver input to receiver output, explicit to implicit	R = 0, i.e. short circuit (see Figure 8)		100	135	ns
		R=10 kΩ		155	185	
		R=100 kΩ		830	990	

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

## Overtemperature protection

Symbol	Parameter	Test condition	Minimum	Typical case	Maximum	Unit
Overtemperature shutdown	Tj(sd)		155	165	180	°C

(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
$T_{WAKE}$	Sleep to wake time	RS Joining square wave (see Figure 7)		3	5	us
$V_{ref}$	Base output voltage	$-5\mu A < I_{ref} < 5\mu A$	$0.45V_{CC}$		$0.55V_{CC}$	V
		$-50\mu A < I_{ref} < 50\mu A$	$0.4V_{CC}$		$0.6V_{CC}$	V
$I_{RS}$	High speed mode input current	$V_{RS} < 1V$	-450		0	$\mu A$
$V_{RS}$	Sleep input voltage	$0 < V_{RS} < V_{CC}$	$0.75V_{CC}$		$V_{CC}$	V
$I_{off}$	Dropping leakage current	$V_{CC}=0V$ , $V_{CANH}=V_{CANL}=5V$	-250		250	$\mu A$

(If not otherwise stated,  $V_{CC}=3.3V \pm 10\%$ ,  $Temp=T_{MIN}-T_{MAX}$ , typical value in  $V_{CC}=+3.3V$ ,  $Temp = 25$  )

## supply current

Parameter	Symbol	Test condition	Minimum	Typical case	Maximum	Unit
Power consumption in hibernation mode	$I_{CC}$	$R_S=V_{CC}$ , $V_I=V_{CC}$		0.04	1	$\mu A$
Visible power consumption		$V_I=0V$ , $R_S=0V$ , $LOAD=60\Omega$		50	70	mA
Hidden power consumption		$V_I=V_{CC}$ , $R_S=0V$ , NO LOAD		6	10	mA

(If not otherwise stated,  $V_{CC}=3.3V \pm 10\%$ ,  $Temp=T_{MIN}-T_{MAX}$ , typical value in  $V_{CC}=+3.3V$ ,  $Temp = 25$  )

## Function table

Table 1 Receiver characteristics in common mode 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= not related



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Table 2 Working mode

RS pin	Pattern	Actuator	Acceptor	RXD pin
Low level, $V(R_s) < 1.2V$ , strong pull down to GND	High speed mode	Enable (on) high	Enable (turn on)	Reflects the bus status
Low level, $V(R_s) < 1.2V$ , pulled down to GND through a resistor in the range of 10k to 100k	Slope control mode	Enable (on) high, with slope control	Enable (turn on)	Reflects the bus status
High level, $V(R_s) > 0.75V_{CC}$	Sleep mode	Disallowed (disabled)	Disallowed (disabled)	High level

Table 3 Driver functions

Import D	$R_s$	Output		General vehicle status
		CANH	CANL	
L	$V(R_s) < 1.2V$ (including pull-down to GND through resistors in the range of 10k to 100k )	H	L	Dominance
H		Z	Z	Covert gender
Open a way	Sleep mode	Z	Z	Covert gender
X	$V_{(R_s)} > 0.75V_{CC}$	Z	Z	Covert gender

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

Table 4 Receiver functions

$V_{ID}=CANH-CANL$	$R_s$	Output R
$V_{ID} \geq 0.9V$	X	L
$0.5 < V_{ID} < 0.9V$	X	?
$V_{ID} \leq 0.5V$	X	H
Open	X	H

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



## test circuit

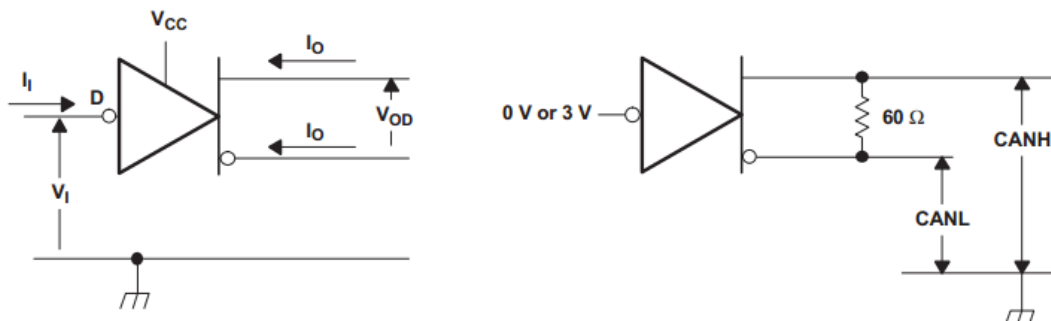


Figure 1 Definition of driver voltage and current test

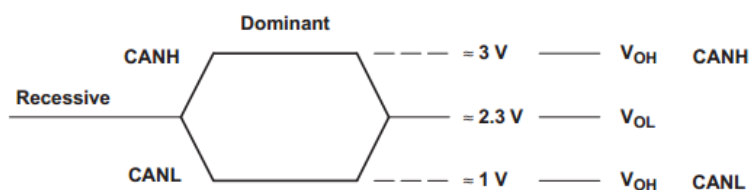


Figure 2 Bus logic voltage definition

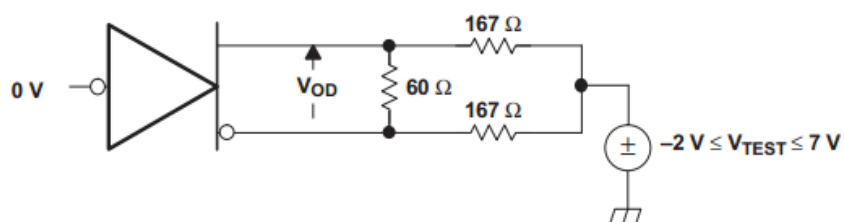
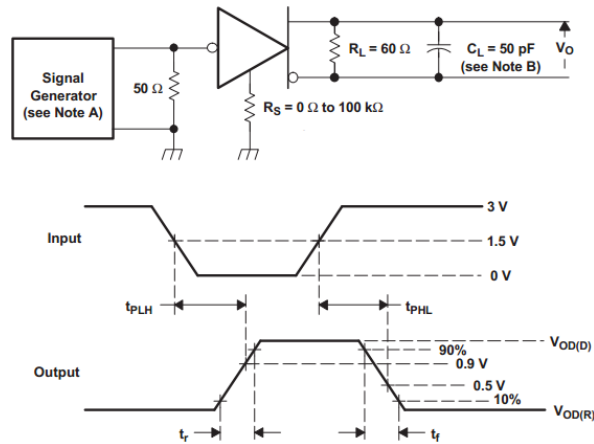


Figure 3 Driver VOD test circuit



A. Characteristics of input pulse generator: PRR is less than or equal to 500KHz, duty cycle is 50%,  $t_r$  is less than 6ns,  $t_f$  is less than 6ns,  $Z_o$  is 50

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

Figure 4 Driver test circuit and voltage waveform

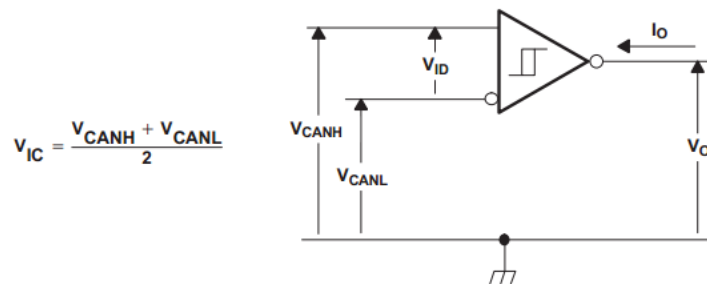
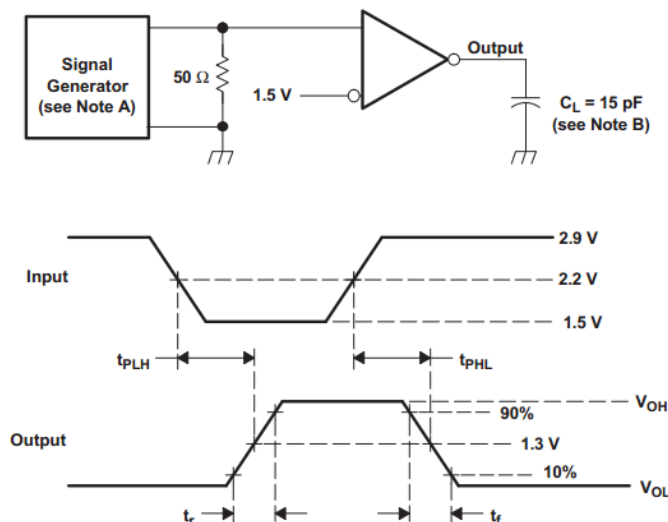


Figure 5 Receiver voltage and current definition



A. Characteristics of input pulse generator: PRR is less than or equal to 500KHz, duty cycle is 50%,  $t_r$  is less than or equal to 6ns,  $t_f$  is less than or equal to 6ns,  $Z_o$  is 50

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

Figure 6 Receiver test circuit and voltage waveform



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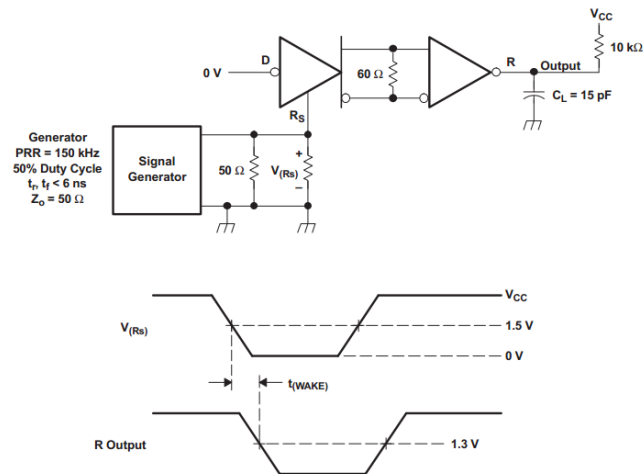
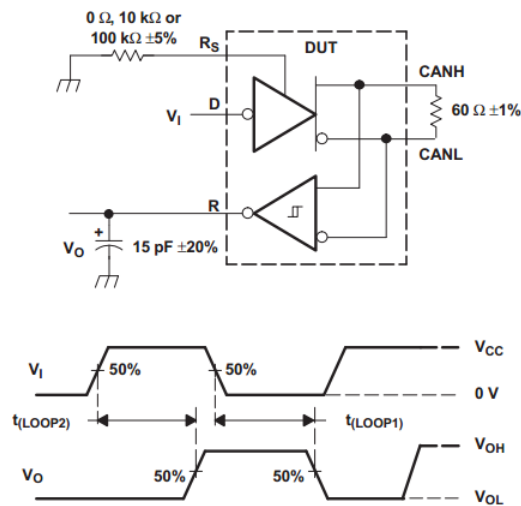


Figure 7 t (WAKE) test circuit and voltage waveform



A. Characteristics of input pulse generator: PRR is less than or equal to 125KHz, 50% duty cycle,  $t_r < 6 \text{ ns}$ ,  $t_f < 6 \text{ ns}$ ,  $Z_o = 50$

Figure 8 t (LOOP) test circuit and voltage waveform



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explain

## 1 resume

SIT65HVD231 is an interface chip used between CAN protocol controllers and physical buses, featuring a low current sleep mode of up to  $1\mu\text{A}$ . 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. The data rate can reach up to 1Mbps, fully compatible with the "ISO 11898" standard.

## 2 short-circuit protection

The drive level of SIT65HVD231 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

SIT65HVD231 It has overtemperature protection function. When the junction temperature exceeds  $160^\circ\text{C}$ , 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 work normally.

## 4 Electrical transient protection

Electrical transients often occur in automotive applications, and SIT65HVD231'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, slope control mode can be employed.

If the application requires both high-speed and low-power sleep 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 ( $<1.2\text{V}$ ), the device enters high-speed mode; when the controller outputs a logic high level ( $>0.75\text{VCC}$ ), the device enters sleep 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  $10\text{k}\Omega$  ~  $100\text{k}\Omega$ ).

### (3) Sleep mode

If a logic high level ( $>0.75\text{VCC}$ ) is applied to the RS (pin 8), the device circuit will enter ultra-low current sleep mode. During this mode, both the driver and receiver are turned off. In this sleep mode, communication between the device and the bus will be impossible. The device will remain in sleep mode until the RS pin is reactivated by applying a logic low level.







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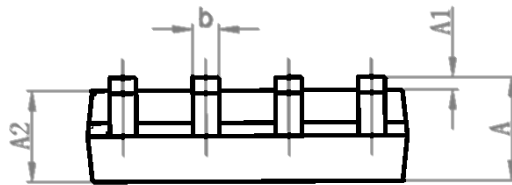
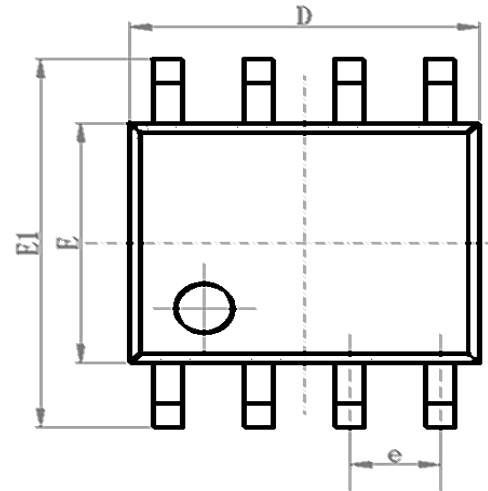
SIT65HVD231

3.3V power supply, high electrostatic protection, ultra-low sleep power consumption, 1Mbps high-speed CAN bus transceiver

## 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
$\theta$	-2 °	-4 °	-6 °





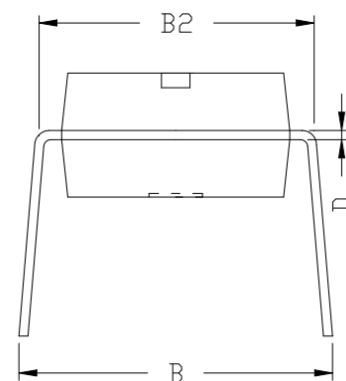
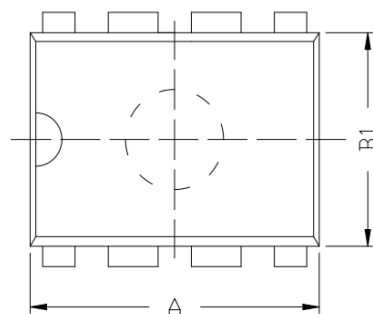
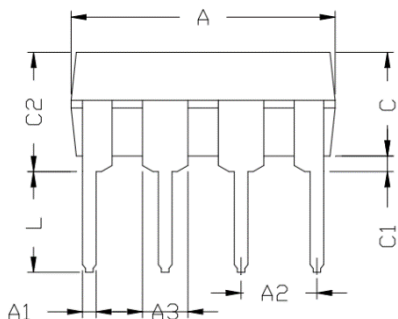
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sleep power consumption, 1Mbps high-speed CAN bus transceiver

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
SIT65HVD231DR	-40°C~125°C	SOP8
SIT65HVD231P	-40°C~125°C	DIP8

The tape packaging is 2500 beads per disc