FEATURES

- Operates with a single 3.3V supply;
- Common mode range exceeds the ISO 11898 standard up to -7V ~ +12V;
- Bus pin ESD protection exceeds ±12kV Human Body Model (HBM);
- Adjustable driver transition times for improved emissions performance;
- Four operating modes: high-speed, slope control, standby, and low-current shutdown (shutdown current as low as 1μA);
- Designed for data rates up to 1Mbps;
- Thermal shutdown protection;
- Open circuit fail-safe design;
- Glitch-free power-up and power-down protection for hot plugging applications

OUTLINE

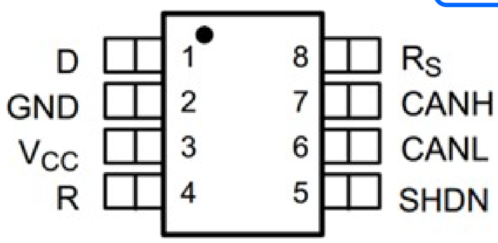
Provide green and environmentally friendly lead-free packaging

DESCRIPTION

The SIT3051 is an interface chip used between the CAN protocol controller and the physical bus. It is designed for use with the 3.3V microprocessors, microcontrollers and digital signal processors with CAN controllers, or with equivalent protocol controller devices. It has four operating modes: high speed, slope control, standby, and low current shutdown. The common mode range can reach -7V~+12V. It is used in industrial automation, control, sensors and drive systems, motor and robotic control, building and temperature control (HVAC), telecom and base station control and status and other fields.

Parameter	Symbol	Test Conditions	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}		-36	+36	V
Differential bus voltage	V_{diff}		1.5	3.0	V
Ambient temperature	T_{amb}		-40	125	°C

PIN CONFIGURATION



LIMITING VALUES

Parameter	Symbol	Size	Unit
Supply voltage	V_{CC}	-0.3~+6	V
DC voltage on D/R pins	D, R	-0.5~VCC+0.5	V
Bus side input voltage	CANL, CANH	-36~36	V
Transient voltage on pins 6, 7	V_{tr}	-100~+100	V
Receiver output current, I_O		-11~11	mA
Storage temperature range		-40~150	°C
Ambient temperature range		-40~125	°C
Welding temperature range		300	°C
Continuous power consumption	SOP8	400	mW
	DIP8	700	mW

The maximum limit parameter value 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. Continuous operation of the device under the maximum allowable rating may affect the reliability of the device. The reference point of all voltages is ground.

PINNING

Pin number	Pin name	Pin function
1	D	CAN transmit data input (low level in the dominant bus state; high level in the recessive bus state), also known as TXD, driver input. TXD has an internal pull-up resistor to VCC.
2	GND	Ground connection
3	VCC	Transceiver 3.3V supply voltage
4	R	CAN receive data output (low level in dominant bus state; recessive bus state The bottom is high level), also known as RXD, driver output
5	SHDN	Shutdown input, CMOS/TTL-compatible. Drive SHDN high to put the SIT3051 in shutdown. SHDN has an internal pull-down resistor to GND.
6	CANL	Low level CAN bus line
7	CANH	High level CAN bus line
8	R_S	Mode selection pin: - strong pull-down to GND = high-speed mode; - strong pull-up to VCC = low power consumption mode; - pull down to GND through a 10kΩ to 100kΩ resistor = slope control mode.

BUS TRANSMITTER DC CHARACTERISTICS

Symbol	Parameter		Test Conditions	Min	Typ	Max	Unit
$V_{O(D)}$	Output voltage (dominant)	CANH	VI=0V, R_S=0V, R_L=60Ω (See Figure 1, Figure 2)	2.45		VCC	V
		CANL		0.5		1.25	
$V_{OD(D)}$	Differential output voltage (dominant)		VI=0V, R_S=0V, R_L=60Ω (See Figure 1)	1.5	2	3	V
			VI=0V, R_L=60Ω, R_S =0V (See Figure 3)	1.2	2	3	V
$V_{O(R)}$	Output voltage (recessive)	CANH	VI=3V, R_S=0V, R_L=60Ω (See Figure 1)		2.3		V
		CANL			2.3		
$V_{OD(R)}$	Differential output voltage (recessive)		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, V_{SHDN}=0V	-250			mA
			CANH=12V, V_{SHDN}=0V			1	
			CANL=-7V, V_{SHDN}=0V	-1			
			CANL=12V, V_{SHDN}=0V			250	
C_O	Output capacitance		See receiver				
I_{CC}	Supply current		V_I=0V (dominant), 60Ω load		35	70	mA
			V_I=0V (dominant), no load			6	mA
			V_I=VCC (recessive), no load			6	mA

(If not otherwise stated, V_{CC}=3.3V±10%, Temp=T_{MIN}~T_{MAX}, the typical value is V_{CC}=+3.3V, Temp=25°C)

BUS TRANSMITTER SWITCHING CHARACTERISTICS

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
t_{PLH}	Propagation delay time (low-to-high level)	R=0, short circuit (see Figure 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 (see Figure 4)		70	120	
		R=10 kΩ		130	180	
		R=100 kΩ		870	1200	
$t_{sk(p)}$	Pulse skew	R=0, short circuit (see Figure 4)		35		

	(| t_{PLH} - t_{PHL} |)	R=10 kΩ		60		
		R=100 kΩ		370		
tr	Output signal rise time	R=0, short circuit (see Figure 4)	20		80	
		R=10 kΩ	30		160	
		R=100 kΩ	300		1400	
tf	Output signal fall time	R=0, short circuit (see Figure 4)	20		80	
		R=10 kΩ	30		160	
		R=100 kΩ	300		1400	

(If not otherwise stated, V_{CC}=3.3V±10%, Temp=T_{MIN}~T_{MAX}, the typical value is V_{CC}=+3.3V, Temp=25°C)

BUS RECEIVER DC CHARACTERISTICS

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{IT+}	Receiver positive threshold	High-speed mode, see Table 1		750	900	mV
		VRS=3V (standby mode)			1100	mV
V_{IT-}	Receiver negative threshold	High-speed mode, see Table 1	500	650		mV
		VRS=3V (standby mode)	500			mV
V_{hys}	Hysteresis interval	VIT+- VIT-		100		mV
V_{OH}	High level output voltage	-6V< V_{ID}< 500mV I_O=-8mA (See figure 5)	2.4			V
V_{OL}	Low level output voltage	900mV< V_{ID}< 6V I_O=8mA (See figure 5)			0.4	V
I_i	Bus input current	VIH=12V, VCC=0V	100		600	μA
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	Input resistance		20	35	50	KΩ
R_{diff}	Differential input resistance		40		100	KΩ
C_i	Input capacitance			40		pF
C_{diff}	Differential input capacitance			20		pF

BUS RECEIVER SWITCHING CHARACTERISTICS

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
t_{PLH}	Propagation delay time (low-to-high level)	See figure 6		35	60	ns
t_{PHL}	Propagation delay time (high-to-low level)	See figure 6		35	60	ns
t_{sk}	Pulse skew	$\|t_{PHL} - t_{PLH}\|$			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, V_{CC}=3.3V±10%, Temp=T_{MIN}~T_{MAX}, the typical value is V_{CC}=+3.3V, Temp=25°C)

DEVICE SWITCHING CHARACTERISTICS

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
$t_{(LOOP1)}$	Loop delay 1, driver input to receiver output, recessive to dominant	R=0, 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, dominant to recessive	R=0, short circuit (see Figure 8)		70	165	ns
		R=10 kΩ		105	190	ns
		R=100 kΩ		535	1000	ns

(If not otherwise stated, V_{CC}=3.3V±10%, Temp=T_{MIN}~T_{MAX}, the typical value is V_{CC}=+3.3V, Temp=25°C)

OVER TEMPERATURE PROTECTION

Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Over temperature shutdown	Tj(sd)		155	165	180	°C

(If not otherwise stated, V_{CC}=3.3V±10%, Temp=T_{MIN}~T_{MAX}, the typical value is V_{CC}=+3.3V, Temp=25°C)

CONTROL PIN CHARACTERISTICS

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
T_{WAKE}	Standby to wake up time	R_S connected to 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}	0.75V_{CC}		VCC	V
I_{off}	Power-down leakage current	Vcc=0V, VCANH=VCANL=5V	-250		250	µA
V_{IH}	High level input voltage		2		VCC+0.3	V
V_{IL}	Low level input voltage		-0.3		0.8	V

(If not otherwise stated, V_{CC}=3.3V±10%, Temp=T_{MIN}~T_{MAX}, the typical value is V_{CC}=+3.3V, Temp=25°C)

SUPPLY CURRENT

Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Shutdown mode power consumption	ISHDN	V_{SHDN}=3V			1	µA
Standby mode power consumption	Istandby	R_S=VCC, V_I=VCC		8	15	µA
Dominant power consumption	ICC	V_I=0V, R_S=0V, LOAD=60Ω		35	70	mA
Recessive power consumption	ICC	V_I=VCC, R_S=0V, NO LOAD			6	mA

(If not otherwise stated, V_{CC}=3.3V±10%, Temp=T_{MIN}~T_{MAX}, the typical value is V_{CC}=+3.3V, Temp=25°C)

FUNCTION TABLE

Table 1 Receiver characteristics over common 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=irrelevant

Table 2 Driver functions

INPUTS			OUTPUTS		
D	**SHDN**	**R_S**	**CANH**	**CANL**	**Bus state**
X	X	>0.75V_{CC}	Z	Z	Reccessive
L	L or open	<0.33V_{CC}	H	L	Dominant
H or open	X		Z	Z	Reccessive
X	H	0.33V_{CC}	Z	Z	Reccessive

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

Table 3 Receiver functions

INPUTS				OUTPUT
Bus state	**V_{ID}=CANH-CANL**	**SHDN**	**D**	**R**
Dominant	$V_{ID} \geq 0.9V$	L or open	X	L
Recessive	$V_{ID} \leq 0.5V$ or open	L or open	H or open	H
?	$0.5 < V_{ID} < 0.9V$	L or open	H or open	?
X	X	H	X	H

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

TEST CIRCUIT

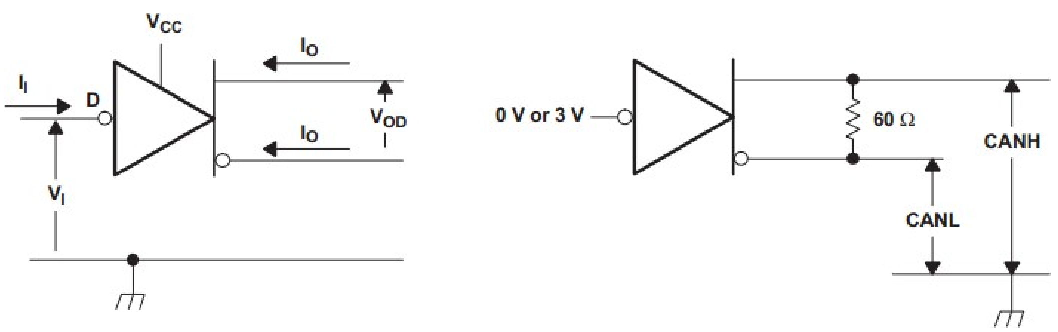


Figure 1 Driver Voltage And Current Definition

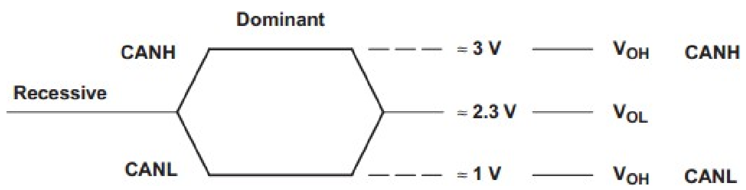


Figure 2 Bus Logic State Voltage Definition

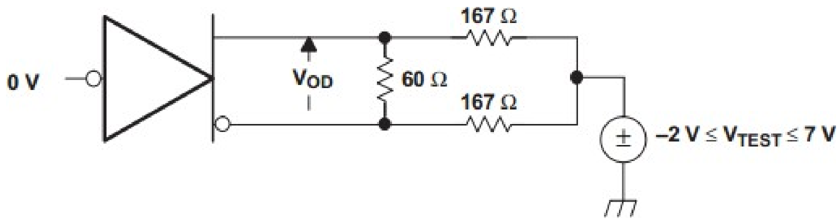
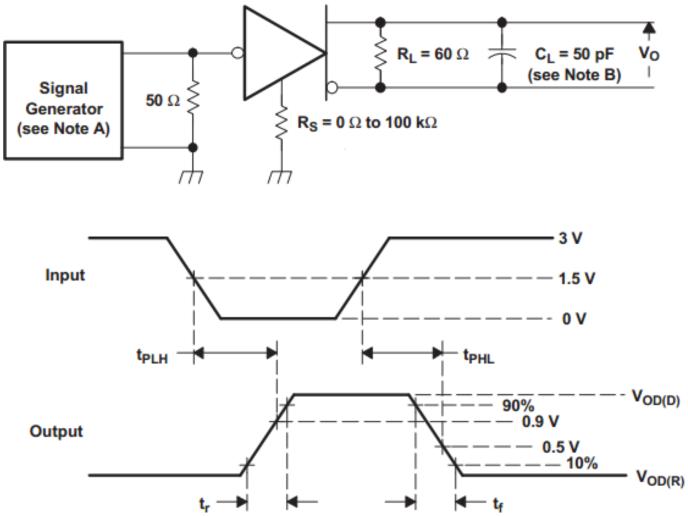


Figure 3 Driver V_{OD} Test Circuit



A. The input pulse is supplied by a generator having the following characteristics
PRR ≤ 500kHz, 50% duty cycle, tr < 6ns, tf < 6ns, Zo=50Ω

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

Figure 4 Driver Test Circuit and Waveform

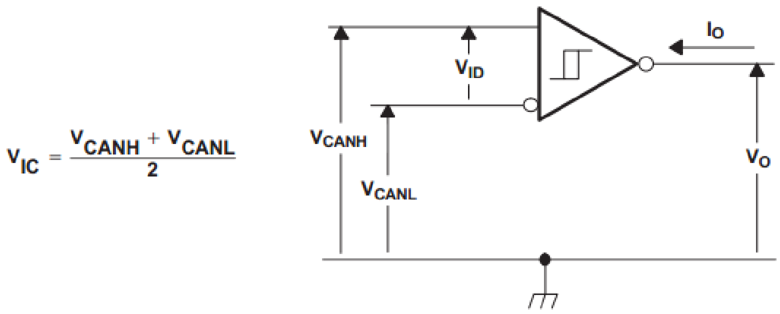
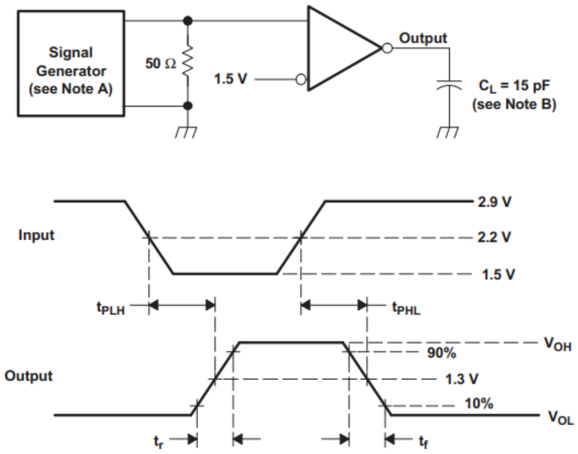


Figure 5 Receiver Voltage and Current Definition



A. The input pulse is supplied by a generator having the following characteristics
PRR ≤ 500kHz, 50% duty cycle, tr < 6ns, tf < 6ns, Zo=50Ω

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

Figure 6 Receiver Test Circuit and Waveform

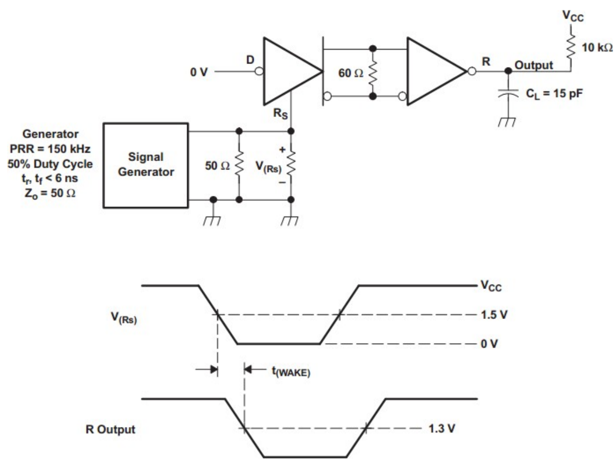
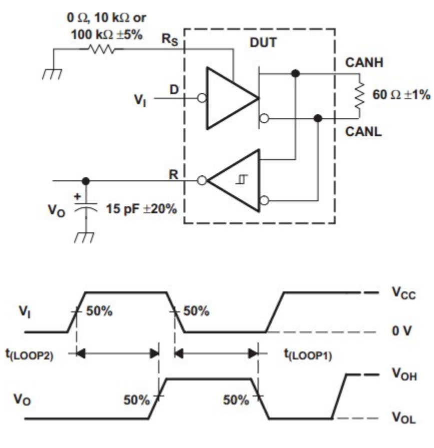


Figure 7 $t_{(WAKE)}$ Test Circuit and Waveform



A. The input pulse is supplied by a generator having the following characteristics
PRR ≤ 125kHz, 50% duty cycle, tr < 6ns, tf < 6ns, Zo=50Ω

Figure 8 $t_{(LOOP)}$ Test Circuit and Waveform

DESCRIPTION

1 Brief description

The SIT3051 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. It is designed for data rates up to 1 Mbps and 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 SIT3051 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 SIT3051 has an integrated over-temperature protection circuit. If the junction temperature exceeds 165°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 SIT3051 are also protected against electrical transients.

5 Control mode

Four different operating modes are provided through the SHDN pin (pin 5) and the RS pin (pin 8): high-speed mode, slope control mode, standby mode and low-power shutdown mode.

(1) High-speed mode:

When a logic low level is applied to SHDN (pin 5), high-speed mode can be selected by applying logic low level to RS pin (pin 8) and SHDN pin (pin 5) High-speed working mode is usually used in industrial applications. The high-speed mode allows the output to switch as fast as possible, and there are no internal restrictions on the output rise and fall slopes. If the high-speed mode affects radiation performance, you can use the slope control mode.

If the application requires the use of high-speed and low-power standby modes, the mode selection pin can be directly connected to the 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 are still using unshielded twisted pair bus cables to reduce system costs, electromagnetic compatibility is critical. The device has a new slope control mode, which can reduce the electromagnetic interference generated by the rise and fall time of the driver and the harmonics generated thereby. When a logic low level is applied to SHDN (pin 5), by connecting a resistor between RS (pin 8) and ground or logic low voltage, the rising and falling slopes of the driver output can be adjusted. The slope of the output signal of the driver is proportional to the output current of the pin, and the slope control is achieved through an external resistor (typically 10kΩ~100kΩ).

(3) Standby mode

When a logic low level is applied to SHDN (pin 5), if a logic high level (> 0.75 VCC) is applied to RS (pin 8), the device will enter a low current, listen only standby mode. During this mode, the driver will be turned off and the receiver will remain working. In this listen-only state, the transceiver is completely passive to the bus. It makes no difference if a slope control resistor is placed or not. When the rising edge of the dominant state (bus differential voltage > 900mV typical value) occurs on the bus, the microprocessor can reverse this low-power standby mode. The microprocessor senses bus activity and reactivates the driver circuit by applying a logic low (< 1.2V) to RS (pin 8).

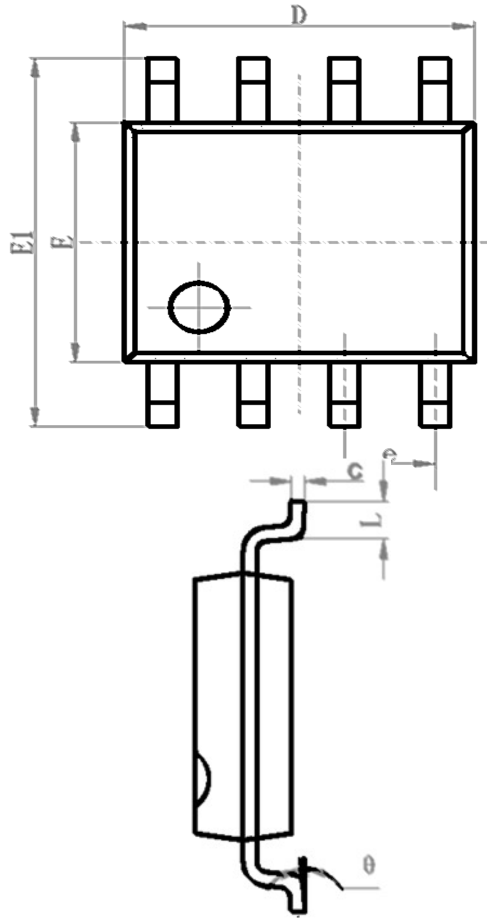
(4) Low-power shutdown mode

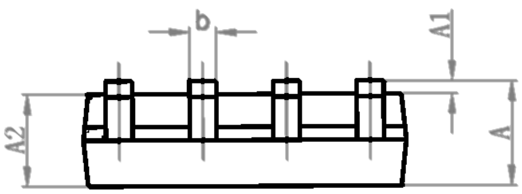
When SHDN is driven high, the device enters shutdown mode. When SHDN is conntected to ground or left unconnected, the device enters normal operating mode.

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°

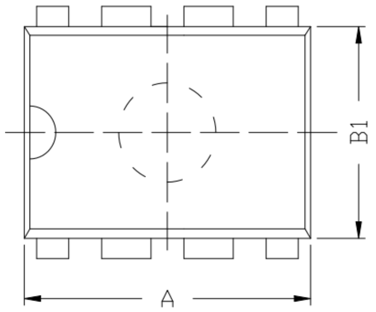


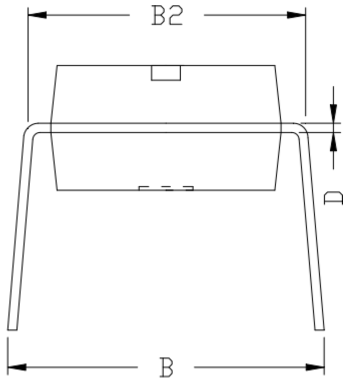


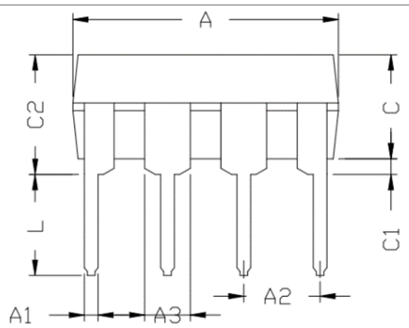
DIP8 DIMENSIONS

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



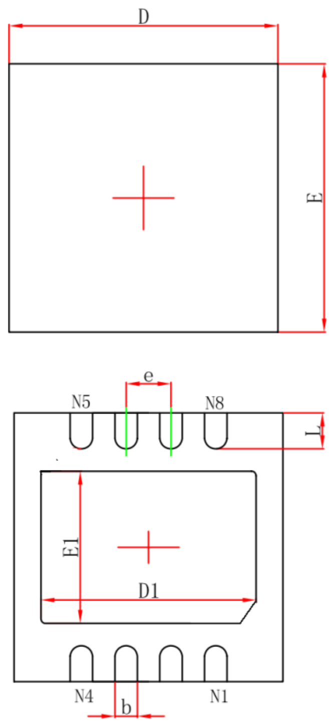


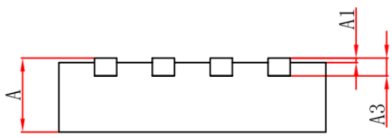


HVSON8 / DFN3*3-8 DIMENSIONS

PACKAGE SIZE

Symbol	Min/mm	Typ/mm	Max/mm
A	0.700		0.900
A1	0.000	0.02	0.050
A3	0.203 REF		
D	2.900	3.000	3.100
E	2.900	3.000	3.100
D1	2.200	2.3	2.400
E1	1.400	1.5	1.600
b	0.2	0.25	0.33
e	0.650 TYP		
L	0.250		0.575





ORDERING INFORMATION

PART NUMBER	TEMPERATURE	PACKAGE
SIT3051ESA	-40°C~125°C	SOP8
SIT3051EPA	-40°C~125°C	DIP8
SIT3051TKΩ	-40°C~125°C	DFN3*3-8/HVSON8 small form factor, leadless

SOP08 tape/reel package is 2500 pieces,
DFN3*3-8/HVSON8 tape/reel package is 3000 pieces