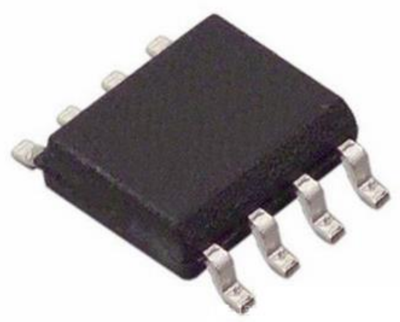
3.3V, High ESD Protected ,1Mbps High Speed CAN Transceiver

FEATURES

- Operates with a single 3.3V supply
- Compatible with ISO 11898-2 standard
- Bus pin ESD protection exceeds ±16 kV HBM
- Up to 120 nodes can be connected
- Adjustable drive conversion time can improve radiation 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

PRODUCT APPEARANCE



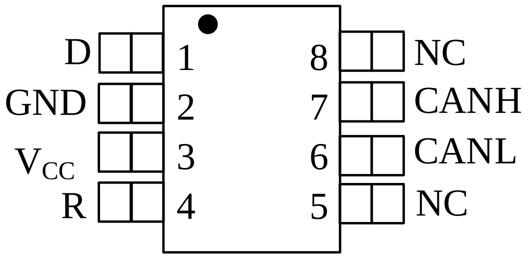
Provide Green and Environmentally Friendly Lead-free package

DESCRIPTION

The SL65HVD232 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 base station 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	°C

PIN CONFIGURATION



PIN DESCRIPTION

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	NC	Not connected
6	CANL	Low level CAN bus line
7	CANH	High level CAN bus line
8	NC	Not connected

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	T_{stg}	-40~150	℃
Virtual junction temperature	T_j	-40~125	℃
Welding temperature range		300	℃
Continuous total power dissipation	SOP8	400	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 ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER		CONDITION	MIN.	TYP.	MAX.	UNIT
$V_{O(D)}$	Output voltage (Dominant)	CANH	VI=0V, R_L=60Ω Fig 1, Fig 2	2.45		VCC	V
		CANL		0.5		1.25	
$V_{OD(D)}$	Differential output voltage (Dominant)		VI=0V, R_L=60Ω Fig 1	1.5	2	3	V
			VI=0V, R_L=60Ω, R_S=0V Fig 3	1.2	2	3	V
$V_{O(R)}$	Output voltage (Recessive)	CANH	VI=3V, R_L=60Ω Fig 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

(VCC=3.3V±10% and Temp=TMIN~TMAX unless specified otherwise; typical in VCC=+5V and Temp=25°C).

DRIVER 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=10kΩ		70	125	
		R=100kΩ		500	870	

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
t_{PHL}	Propagation delay time (high-to-low level)	R=0, short circuit Fig 4		70	120	ns
		R=10kΩ		130	180	
		R=100kΩ		870	1200	
$t_{sk(p)}$	Pulse skew (| t_{PLH} - t_{PHL} |)	R=0, short circuit Fig 4		35		ns
		R=10kΩ		60		
		R=100kΩ		370		
t_r	Differential output signal rise time	R=0, short circuit Fig 4	25	50	100	ns
		R=10kΩ	80	120	160	
		R=100kΩ	600	800	1200	
t_f	Differential output signal fall time	R=0, short circuit Fig 4	40	55	80	ns
		R=10kΩ	80	125	150	
		R=100kΩ	600	825	1000	

(VCC=3.3V±10% and Temp=TMIN~TMAX unless specified otherwise; typical in VCC=+5V and Temp=25°C).

RECEIVER ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
V_{IT+}	Positive-going input threshold voltage	Table 1		750	900	mV
V_{IT-}	Negative-going input threshold voltage	Table 1	500	650		mV
V_{hys}	Hysteresis voltage	VIT+- VIT-		100		mV
V_{OH}	High-level output voltage	-6V<V_{ID}< 500mV, I_O =-8mA, Fig 5	2.4			V
V_{OL}	Low-level output voltage	900mV<V_{ID} < 6V I_O =8mA, 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

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
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				

(VCC=3.3V±10% and Temp=TMIN~TMAX unless specified otherwise; typical in VCC=+5V and Temp=25°C).

RECEIVER SWITCHING CHARACTERISTICS

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

(VCC=3.3V±10% and Temp=TMIN~TMAX unless specified otherwise; typical in VCC=+5V and 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 Fig 7		70	115	ns
		R=10kΩ		105	175	
		R=100kΩ		535	920	
$t_{(LOOP2)}$	Loop delay 2, driver input to receiver output, Dominant to Recessive	R=0, short circuit Fig 7		100	135	ns
		R=10kΩ		155	185	
		R=100kΩ		830	990	

(VCC=3.3V±10% and Temp=TMIN~TMAX unless specified otherwise; typical in VCC=+5V and Temp=25°C).

OVER TEMPERATURE PROTECTION

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Shutdown junction temperature	$T_{j(sd)}$		155	165	180	℃

(VCC=3.3V±10% and Temp=TMIN~TMAX unless specified otherwise; typical in VCC=+5V and Temp=25℃).

SUPPLY

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Dominant power consumption	I_{CC}	V_I=0V, LOAD=60Ω		50	70	mA
Recessive power consumption	I_{CC}	V_I=VCC, No load		6	10	mA

(VCC=3.3V±10% and Temp=TMIN~TMAX unless specified otherwise; typical in VCC=+5V and Temp=25℃).

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 3 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) High level; L=low level; ?=uncertain; X=irrelevant.

TEST CIRCUIT

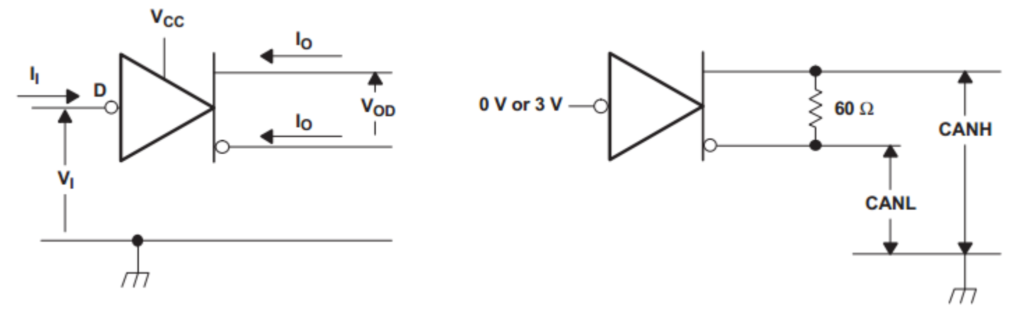


Fig 1 Driver Voltage And Current Definition

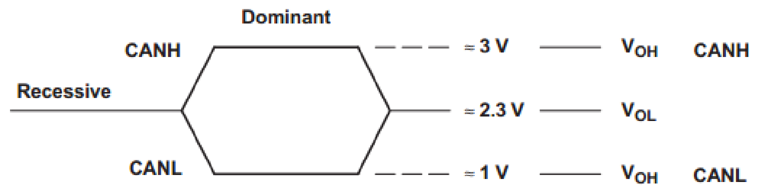


Fig 2 Bus Logic State Voltage Definition

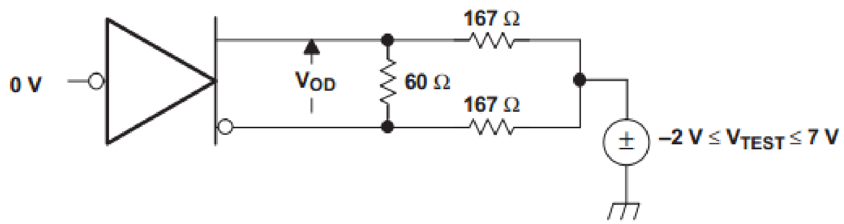
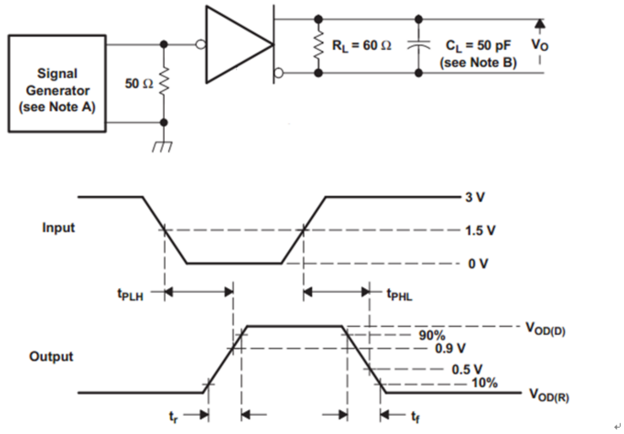


Fig 3 Driver V_{OD} Test Circuit



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

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

Fig 4 Driver Test Circuit and Waveform

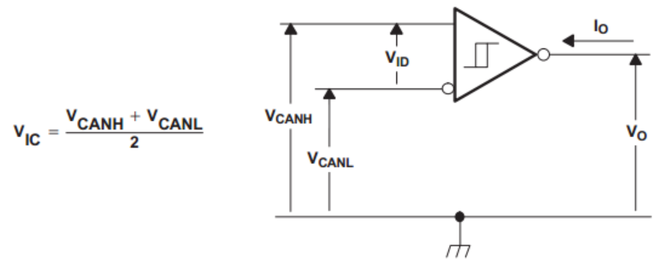
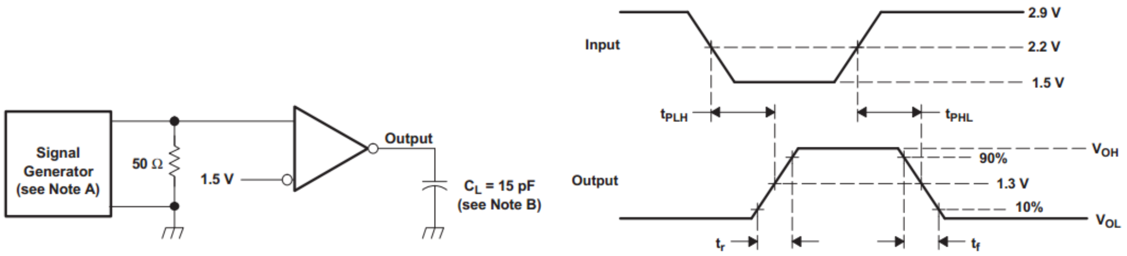


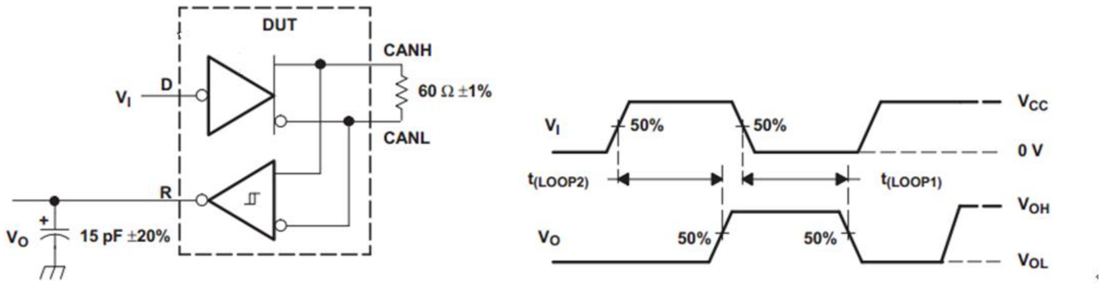
Fig 5 Receiver Voltage and Current Definition



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

B. C_L 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≤500kHz, 50% duty cycle, tr<6ns, t_f<6ns, Zo=50Ω.

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

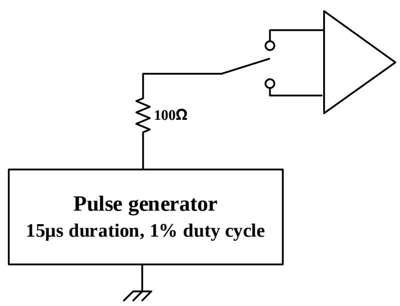


Fig 8 Overvoltage protection

ADDITIONAL DESCRIPTION

1 Brief description

The SL65HVD232 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 base station 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 SL65HVD232 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 SL65HVD232 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 SL65HVD232 are also protected against electrical transients.

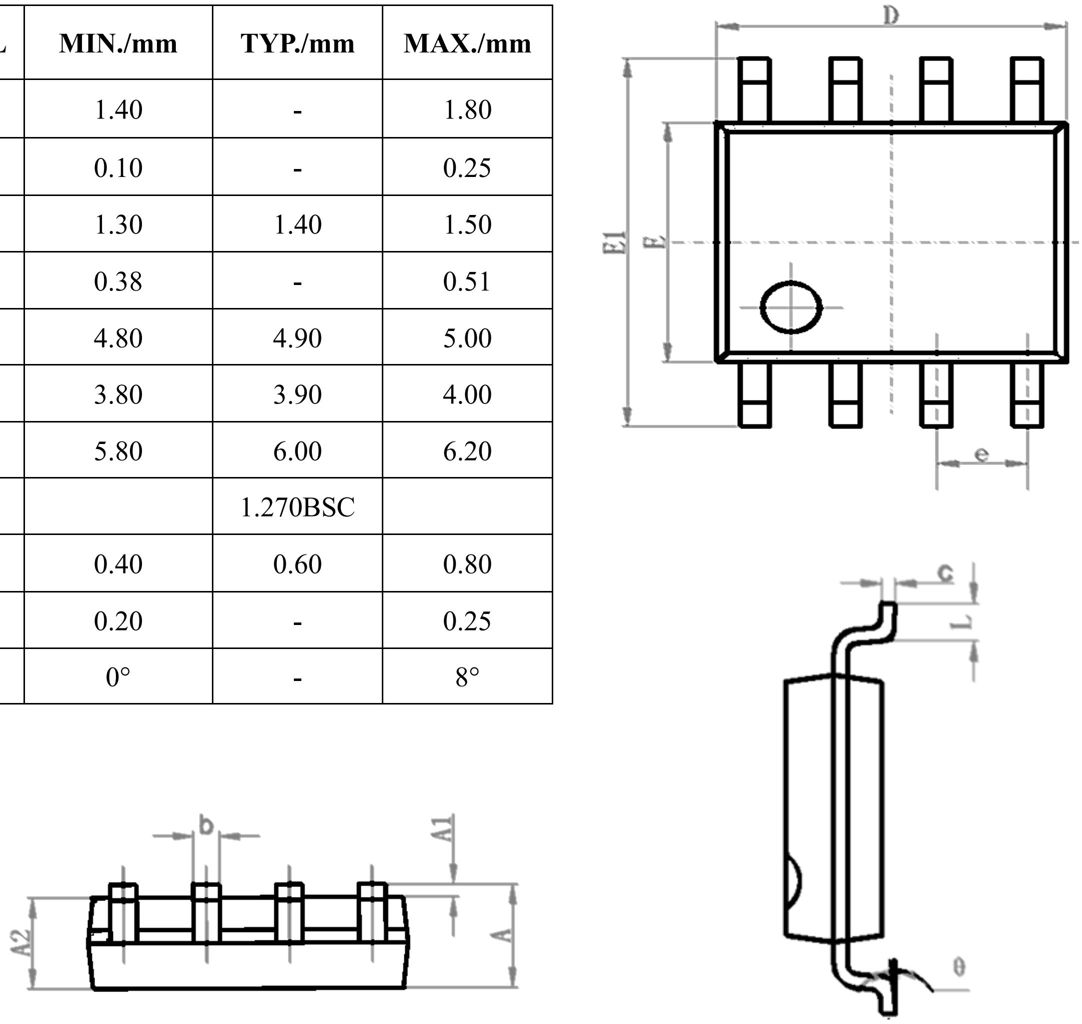
5 Control mode

The SL65HVD232 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

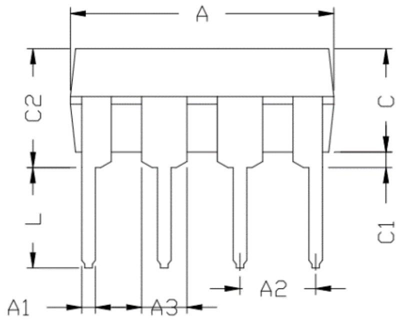
SYMBOL	MIN./mm	TYP./mm	MAX./mm
A	1.40	-	1.80
A1	0.10	-	0.25
A2	1.30	1.40	1.50
b	0.38	-	0.51
D	4.80	4.90	5.00
E	3.80	3.90	4.00
E1	5.80	6.00	6.20
e		1.270BSC	
L	0.40	0.60	0.80
c	0.20	-	0.25
θ	0°	-	8°

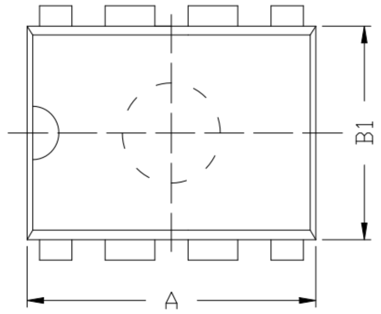


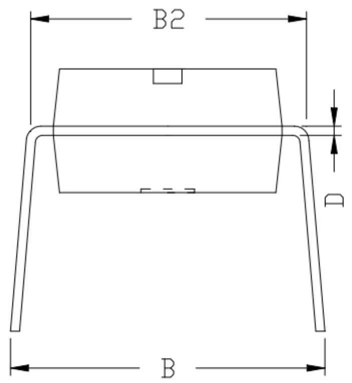
DIP8 DIMENSIONS

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





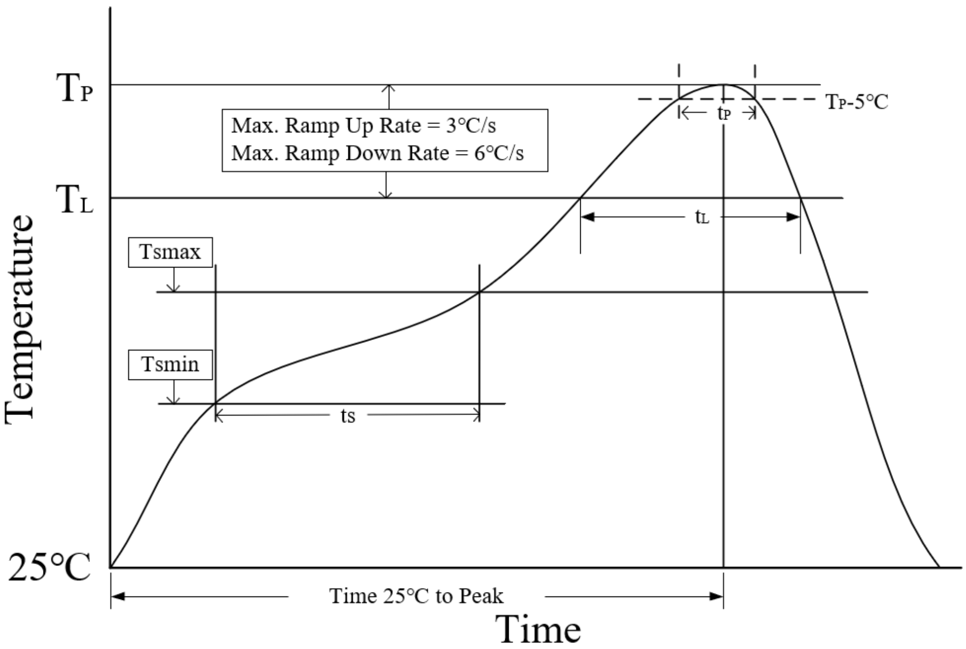


ORDERING INFORMATION

TYPE NUMBER	PACKAGE	PACKING
SL65HVD232DR	SOP8	Tape and reel
SL65HVD232P	DIP8	Tube

SOP8 is packed with 2500 pieces/disc in braided packing. DIP8 is packed with 50 pieces/disc in tubed packing.

REFLOW SOLDERING



Parameter	Lead-free soldering conditions
Ave ramp up rate (T_L to T_P)	3°C/second max
Preheat time ts (T_{smin}=150°C to T_{smax}=200°C)	60-120 seconds
Melting time t_L (T_L=217°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