

3.3-V Supply RS-485

1. Description

- 3.0V~5.5V Wide Power Range, Half-Duplex
- ESD protection for RS-485 I/O pins $\pm 15\text{kV}$ HBM
- Bus fault tolerance and withstand voltage reach $\pm 15\text{V}$
- Driver short-circuit output protection
- Low power off function
- Receiver open-circuit failure protection
- Strong anti-noise ability
- Integrated transient voltage suppression function
- Data transmission up to 20Mbps in an electric noise environment
- provides small shape DFN3*3-8, MSOP8/VSSOP8

2. Features

SN65HVD75 is a RS-485 transceiver with 3.0V~5.5V wide power supply, bus port ESD protection capacity of over 15kV HBM, bus withstand voltage range of $\pm 15\text{V}$, half duplex, low power consumption, and fully meet the requirements of TIA/EIA-485 standard.

SN65HVD75 includes a driver and a receiver, both of which can be enabled and closed independently.

When both are disabled, both the driver and the receiver output are high resistance state. It can realize error-free data transmission up to 20Mbps.

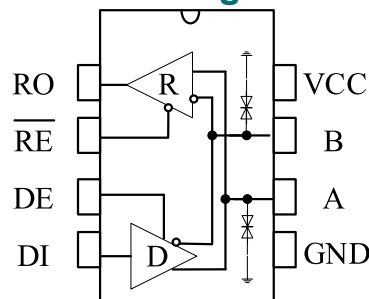
SN65HVD75 has a working voltage range of 3.0~5.5V, and has the functions of fail-safe, over temperature protection, current-limiting protection, over-voltage protection, etc.

3. Ordering Information

Type Number	Package Type	Packing	Notes
SN65HVD75D	SOP-8	Tape & Reel	
SN65HVD75N	DIP-8	Tube	
SN65HVD75DGK	MSOP-8	Tape & Reel	
SN65HVD75DRB	DFN3*3-8	Tape & Reel	

Note: If the physical information is inconsistent with the ordering information, please refer to the actual product.

4. Pin Configuration and Block Diagram



5. Pin Description

PIN	SYMBOL	DESCRIPTION
1	RO	Receiver Output. When /RE is low and if A - B $\geq -10\text{mV}$, RO will be high; if A - B $\leq -200\text{mV}$, RO will be low.
2	$\overline{\text{RE}}$	Receiver Output Enable. Drive /RE low to enable RO; RO is high impedance when /RE is high. Drive /RE high and DE low to enter low-power shutdown mode.

3	DE	Driver Output Enable. Drive DE high to enable driver outputs. These outputs are high impedance when DE is low. Drive/RE high and DE low to enter low-power shutdown mode.
4	DI	Driver Input. With DE high, a low on DI forces non-inverting output low and inverting output high. Similarly, a high on DI forces non-inverting output high and inverting output low.
5	GND	Ground.
6	A	non-inverting Receiver Input and non-inverting Driver Output.
7	B	Inverting Receiver Input and Inverting Driver Output.
8	V _{CC}	Positive Supply.

6. Limiting Values

PARAMETER	SYMBOL	VALUE	UNIT
Supply voltage	V _{CC}	+7	V
Control Input Voltage	\overline{RE} , DE, DI	-0.3~V _{CC} +0.5	V
Receiver Input Voltage	A, B	-15~+15	V
Receiver Output Voltage	R _O	-0.3~V _{CC} +0.5	V
Operating Temperature Ranges	T _A	-40~125	°C
Storage Temperature Range	T _{stg}	-60~150	°C
Lead Temperature		300	°C

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.

7. Driver DC Electrical Characteristics

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Differential Driver Output (No load)	V _{OD1}		2.5		5.5	V
Differential Driver Output	V _{OD2}	Fig 2, R _L =54Ω, V _{CC} =3.3V	1.5	1.8	V _{CC}	V
		Fig 2, R _L =54Ω, V _{CC} =5V	1.5	3	V _{CC}	
Change in Magnitude of Driver Differential Output Voltag ¹	ΔV _{OD}	Fig 2, R _L =54Ω			0.2	V
Driver Common-Mode Output Voltage	V _{OC}	Fig 2, R _L =54Ω			3	V
Change in Magnitude of Common-Mode Output Voltage ¹	ΔV _{OC}	Fig 2, R _L =54Ω			0.2	V
Input High Voltage	V _{IH}	DE, DI, \overline{RE}	2.0			V
Input Low Voltage	V _{IL}	DE, DI, \overline{RE}			0.8	V
Logic Input Current	I _{IN1}	DE, DI, \overline{RE}	-2		2	μA
Output short-circuit current, short-circuit to high	I _{OSD1}	short-circuit to 0V~12V			250	mA
Output short-circuit current, short-circuit to low	I _{OSD2}	short-circuit to -7V~0V	-250			mA

(Unless otherwise noted, Temp=T_{MIN}~T_{MAX}, Temp=25°C).

NOTE1: ΔV_{OD} and ΔV_{OC} are the changes in V_{OD} and V_{OC}, respectively, when the DI input changes state.

8. Receiver DC Electrical Characteristics

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Input current (A, B)	I_{IN2}	$DE=0V, V_{CC}=0$ or $5V, V_{IN}=12V$		500	1000	μA
		$DE=0V, V_{CC}=0$ or $5V, V_{IN}=-7V$	-800	-300		μA
Positive input threshold voltage	V_{IT+}	$-7V \leq V_{CM} \leq 12V$			-10	mV
Reverse input threshold voltage	V_{IT-}	$-7V \leq V_{CM} \leq 12V$	-200			mV
Input hysteresis voltage	V_{hys}	$-7V \leq V_{CM} \leq 12V$	10	30		mV
Receiver Output High Voltage	V_{OH}	$I_{OUT}=-2.5mA, V_{ID}=+200mV$	$V_{CC}-1.5$			V
Receiver Output Low Voltage	V_{OL}	$I_{OUT}=+2.5mA, V_{ID}=-200mV$			0.4	V
Three-State Output Current at Receiver	I_{OZR}	$0.4V < V_O < 2.4V$			± 1	μA
Receiver Input Resistance	R_{IN}	$-7V \leq V_{CM} \leq 12V$	12			k Ω
Receiver Short-Circuit Output Current	I_{OSR}	$0V \leq V_O \leq V_{CC}$	± 8		± 90	mA

(Unless otherwise noted, Temp= $T_{MIN} \sim T_{MAX}$, Temp= $25^{\circ}C$).

9. Supply Current

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{CC1}	$\overline{RE}=0V, DE=0V, V_{CC}=3.3V$		240	650	μA
		$\overline{RE}=0V, DE=0V, V_{CC}=5V$		270	750	μA
	I_{CC2}	$\overline{RE}=V_{CC}, DE=V_{CC}, V_{CC}=3.3V$		360	650	μA
		$\overline{RE}=0V, DE=0V, V_{CC}=5V$		400	750	μA
Shutdown current	I_{SHDN}	$\overline{RE}=V_{CC}, DE=0V, V_{CC}=3.3V$		0.2	10	μA
		$\overline{RE}=V_{CC}, DE=0V, V_{CC}=5V$		0.2	10	μA

10. Driver Switching Characteristics

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Driver differential Output delay	t_{DD}	$R_L=60\Omega, C_L=100pF,$		15	32	ns
Driver differential output Transition time	t_{TD}	Fig 3 & Fig 4		9	20	ns
Drive propagation delay From low to high	t_{PLH}	$R_L=27\Omega, \text{Fig 3 \& Fig 4}$		18	40	ns
Drive propagation Delay From high to low	t_{PHL}			18	40	ns
$ t_{PLH}-t_{PHL} $	t_{PDS}			2	6	ns
Driver Enable to Output High	t_{PZH}		$R_L=110\Omega, \text{Fig 5 \& Fig 6}$		16	45
Driver Enable to Output low	t_{PZL}			16	45	ns
Driver Disable Time from Low	t_{PLZ}	$R_L=110\Omega, \text{Fig 5 \& Fig 6}$		22	85	ns
Driver Disable Time from high	t_{PHZ}			22	85	ns
In Shutdown mode, Enable to Output High	t_{PSH}	$R_L=110\Omega, \text{Fig 5 \& Fig 6}$		20	100	ns
In Shutdown mode, Enable to Output low	t_{PSL}	$R_L=110\Omega, \text{Fig 5 \& Fig 6}$		20	100	ns

11. Receiver Switching Characteristics

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Receiver Input to output from low to high	t _{RPLH}	C _L =15pF, Fig 7 & Fig 8		35	60	ns
Receiver Input to output from high to low	t _{RPHL}			35	60	ns
t _{RPLH} - t _{RPHL}	t _{RPDS}			3	8	ns
Receiver Enable to Output Low	t _{RPZL}	C _L =15pF, Fig 7 & Fig 8		16	30	ns
Receiver Enable to Output high	t _{RPZH}	C _L =15pF, Fig 7 & Fig 8		16	30	ns
Receiver Disable Time from Low	t _{RPLZ}	C _L =15pF, Fig 7 & Fig 8		30	50	ns
Receiver Disable Time from high	t _{RPHZ}	C _L =15pF, Fig 7 & Fig 8		30	50	ns
In Shutdown mode, Enable to Output High	t _{RPSH}	C _L =15pF, Fig 7 & Fig 8		150	500	ns
In Shutdown mode, Enable to Output Low	t _{RPSL}	C _L =15pF, Fig 7 & Fig 8		150	500	ns
Time to Shutdown	t _{SHDN}	NOTE2	50		300	ns

NOTE2: If the enable inputs are RE=high and DE=low for less than 50ns, the device is guaranteed not to enter shutdown. If the enable inputs are in this state for at least 300ns, the device is guaranteed to have entered shutdown.

12. Function Table

Table 1. Driver Function

CONTROL		INPUT	OUTPUT	
\overline{RE}	DE	DI	A	B
X	1	1	H	L
X	1	0	L	H
0	0	X	Z	Z
1	0	X	Z(shutdown)	

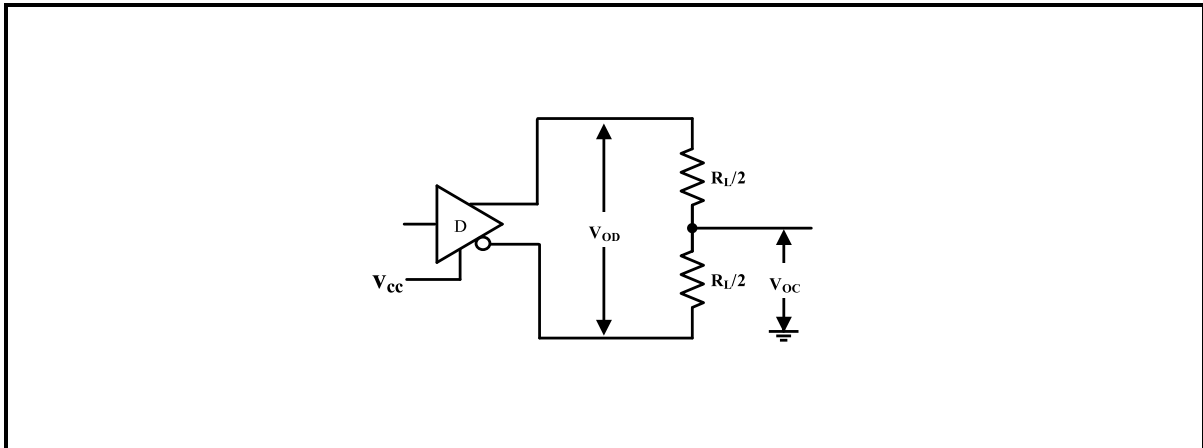
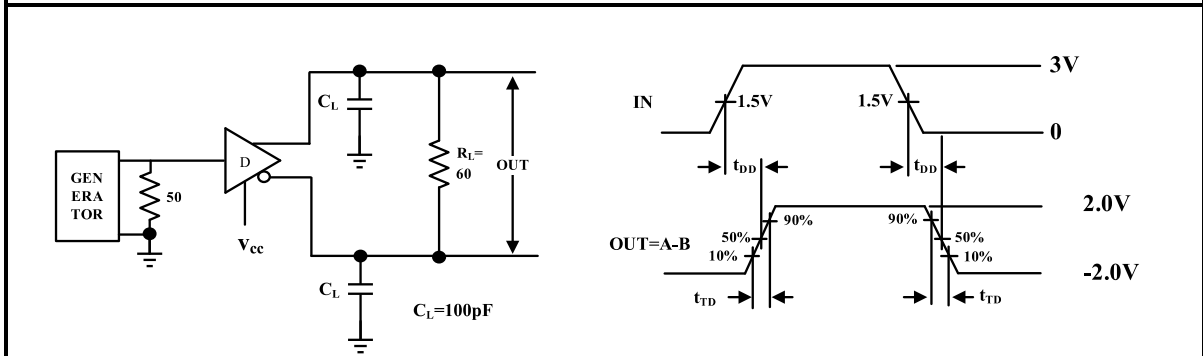
X=irrelevant; Z=high impedance

Table 2. Receiver Function

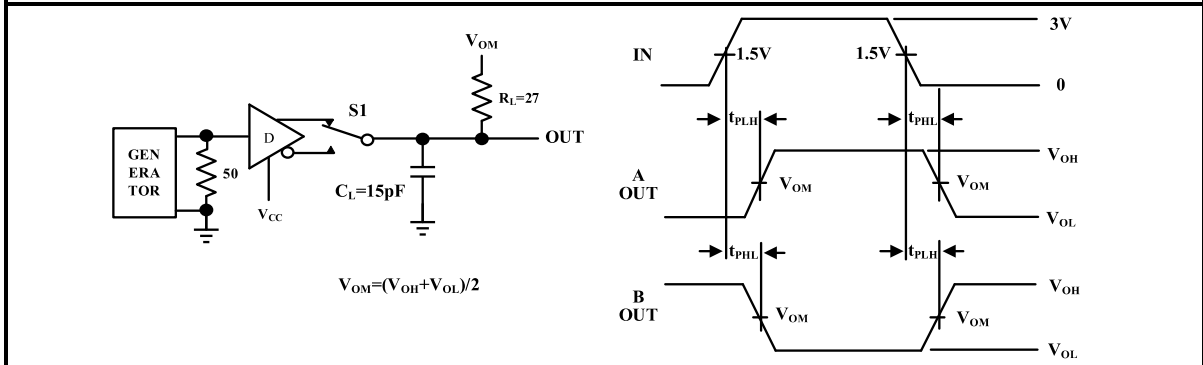
CONTROL		INPUT	OUTPUT
\overline{RE}	DE	A-B	RO
0	X	≥-10mV	H
0	X	≤-200mV	L
0	X	Open/short circuit	H
1	X	X	Z

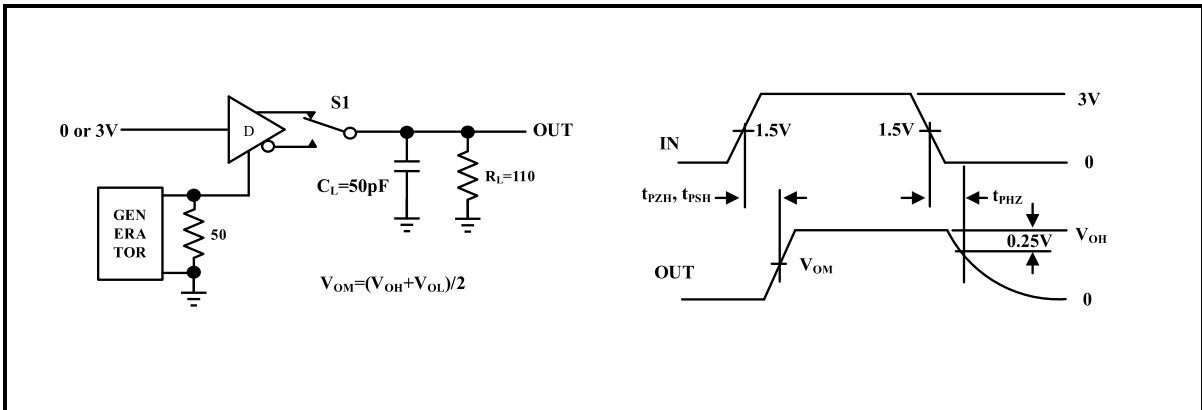
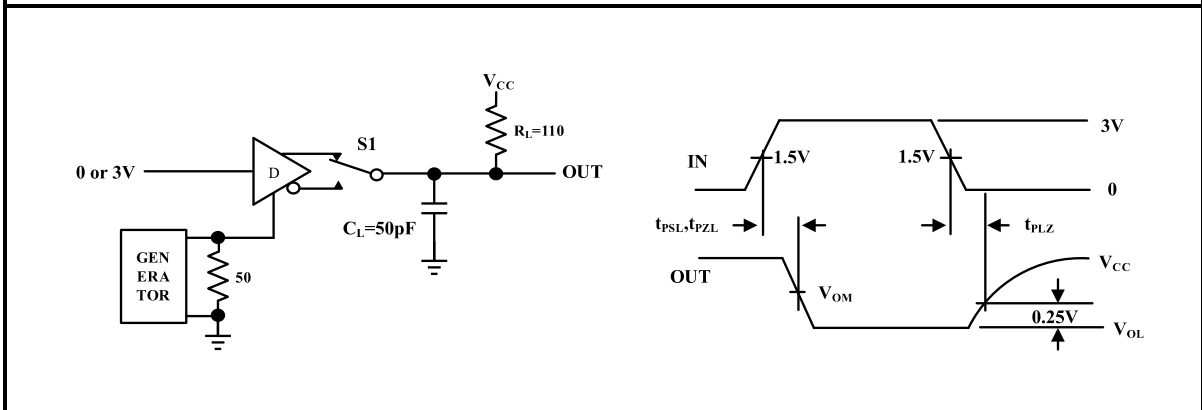
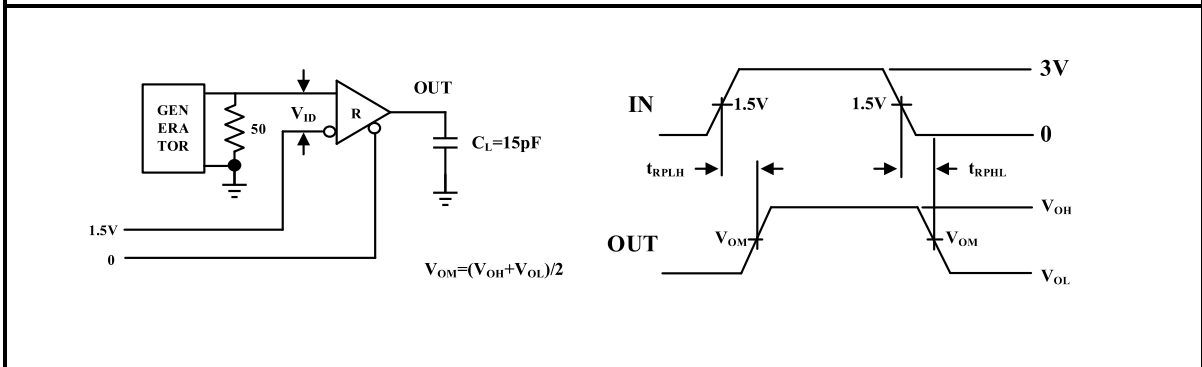
X=irrelevant; Z=high impedance

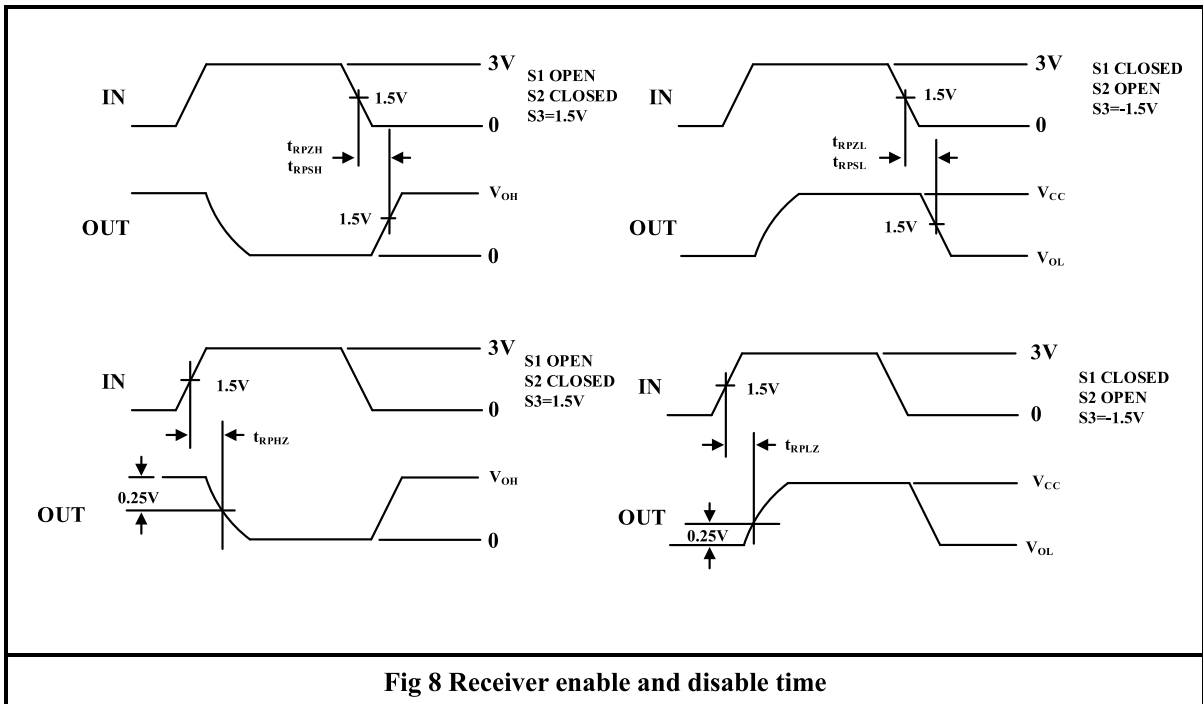
13. Test Circuit


Fig 2 Driver DC test load


CL includes probe and stray capacitance (the same below)

Fig 3 Differential delay and transit time of driver

Fig 4 Drive propagation delay

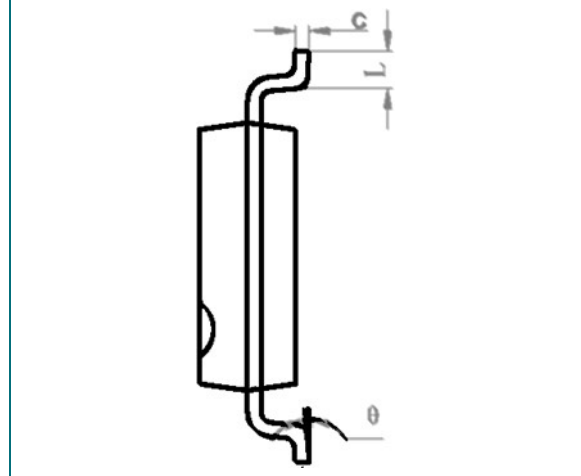
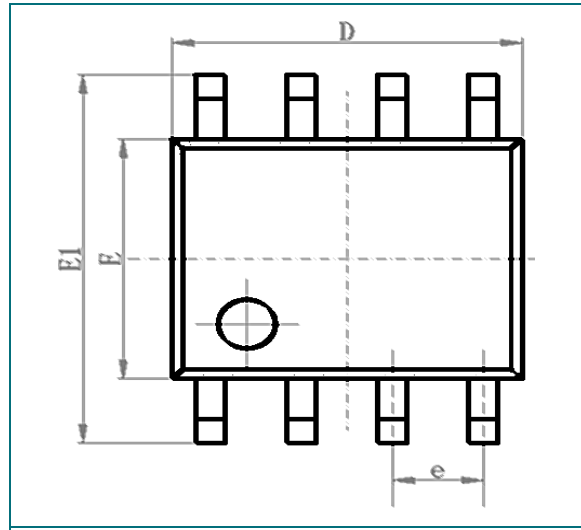
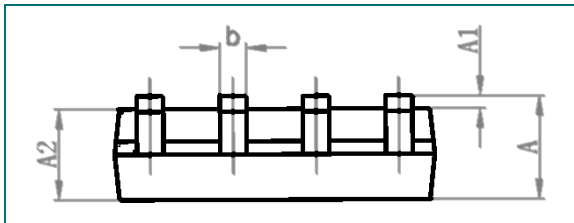

Fig 5 Drive enable and disable time

Fig 6 Drive enable and disable time

Fig7 Receiver propagation delay test circuit


Fig 8 Receiver enable and disable time

14. Package Outlines

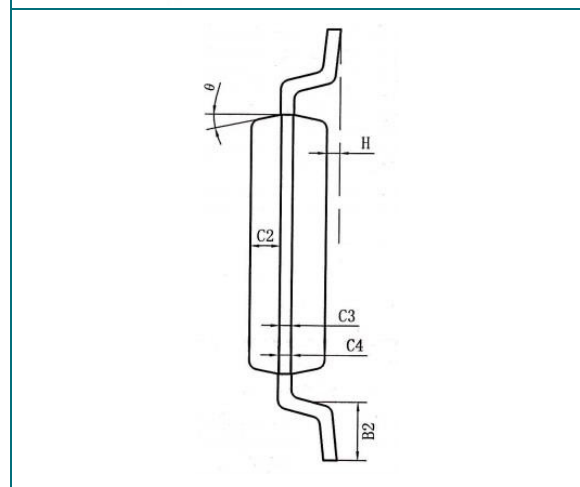
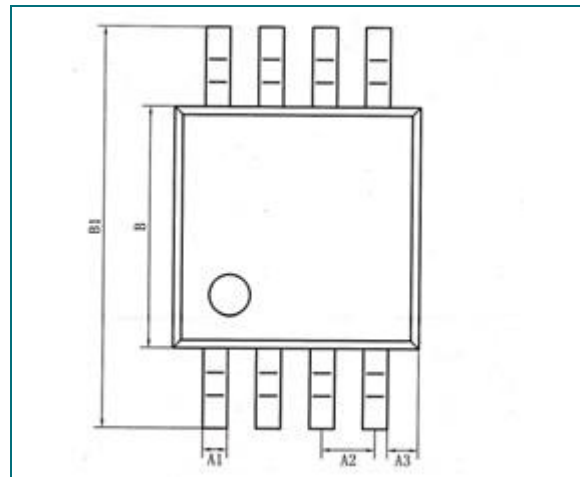
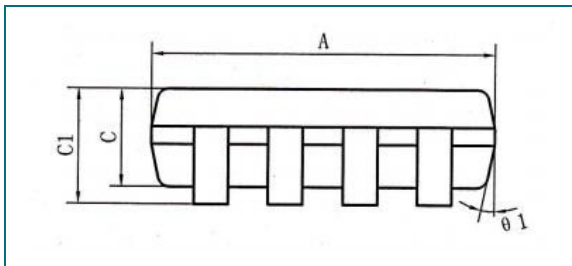
14.1. SOP-8

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°



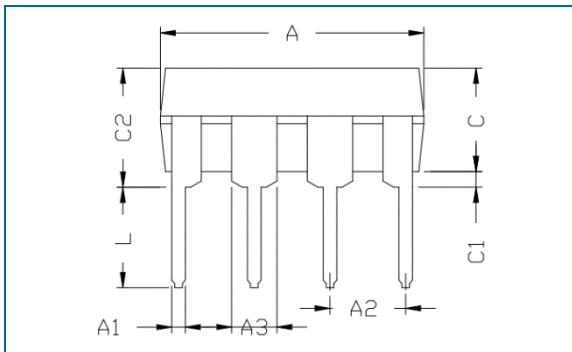
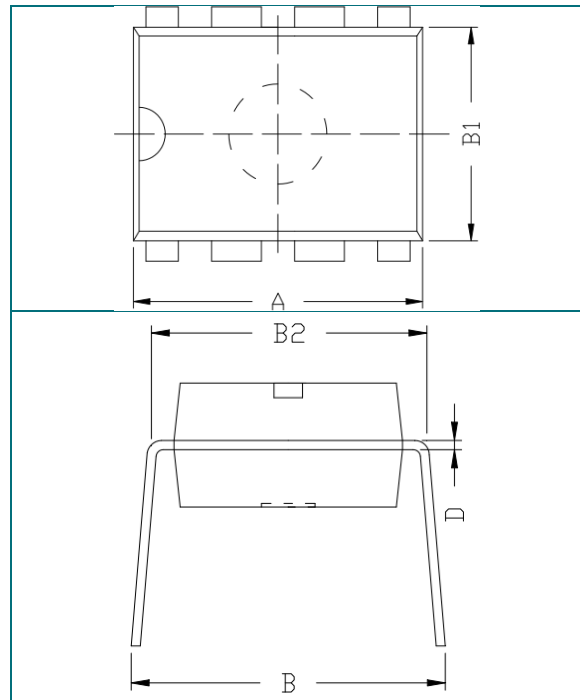
14.2. MSOP-8/VSSOP-8

SYMBOL	MIN./mm	TYP./mm	MAX./mm
A	2.90	3.0	3.10
A1	0.28		0.35
A2	0.65TYP		
A3	0.375TYP		
B	2.90	3.0	3.10
B1	4.70		5.10
B2	0.45		0.75
C	0.75		0.95
C1			1.10
C2	0.328 TYP		
C3	0.152		
C4	0.15		0.23
H	0.00		0.09
θ	12°TYP		



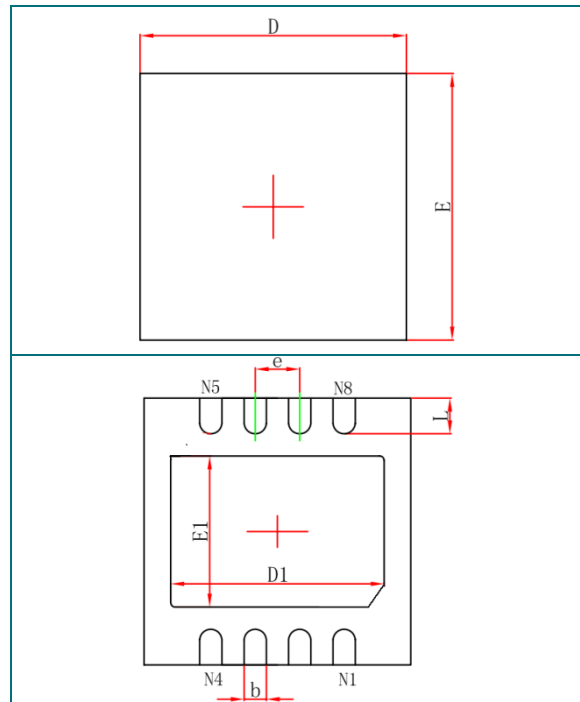
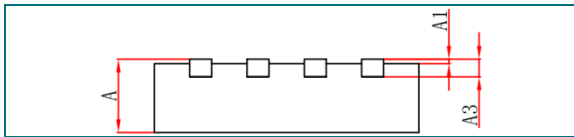
14.3. DIP-8

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



14.4. DFN3*3-8

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	0.65 TYP		
L	0.250		0.575



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