Description

HMAX3485 is 3V to 5.5V power supply, ±15kV anti-static slow limit differential transceiver and can provide complete RS485 compatibility for half-duplex applications. Each section contains a driver and a receiver designed for data transmission over an extended common-mode range (-7V to +12V). It can effectively transmit data at a high rate of up to 15Mbps.

The HMAX3485 series also features enhanced ESD protection function. By using IEC61000-4-2 air gap discharge, the all-transmitter output and receiver input are protected to ±15kV.If adopting HBM, the protection can be ±15kV. If adopting the IEC61000-4-2 contact discharge protection, the protection can be ±8kV.

Drive short-circuit current is limited. When the driver output is placed in a high impedance state through a thermal shutdown circuit, the driver can prevent excessive power consumption. The receiver (R X) input has a“Fail safe ” design that ensures a logically high Rx output when the RX input is floating, shorted, or terminated but not driven.

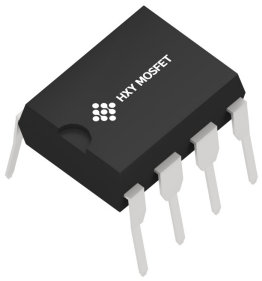
Both components have power-on/off modes, and fault-free driver outputs allow transceivers to be inserted or removed from bus in real time. CMOS designs aim to offer significant power savings without sacrificing overload or ESD damage. Typically, static current is only 300uA in operation and 1uA in shutdown mode.

Feature

- High communication rate, 3.0V ~ 5.5V power supply 15Mbp
- High ESD protection
- Low power consumption down to 1uA, shutdown mode
- Input voltage range: -7V~+12V (common mode)
- Bus connection up to 256 nodes
- Thermal shutdown protection function
- Drive overload protection function
- Full fault-safe (open circuit, short circuit, etc.)

Product Application

- Power communication
- Integrated digital network
- Industrial control local area network
- Power measurement (smart meter)
- Factory automation and control



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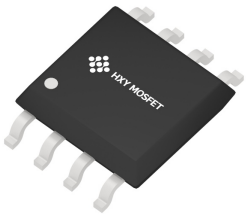

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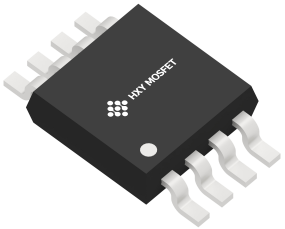
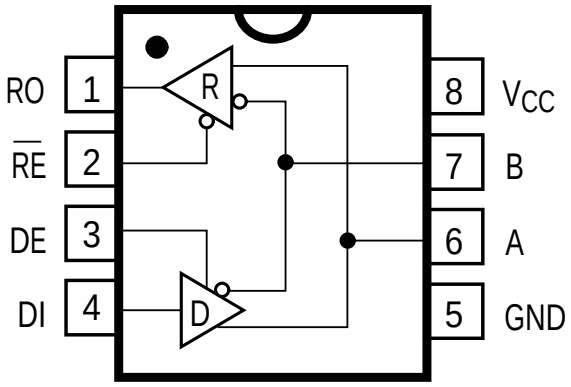


MSOP-8

Ordering Information

Product Model	Package Type	Packing	Packing Qty
HMAX3485EN	DIP-8	Tube	2000Pcs/Box
HMAX3485ESA	SOP-8	Tape	2500Pcs/Reel
HMAX3485EMDTR	MSOP-8	Tape	3000Pcs/Reel

Description of Pins



Function Diagram

Pins		Type	Description
Name	Serial No.		
RO	1	Output	Reverse Output
$\overline{RE}$	2	Input	Reverse Output Enable
DE	3	Input	Drive Enable
DI	4	Input	Drive Input
GND	5	Power	Ground
A	6	I/O	Noninverting Receiver Input and Noninverting Driver Output
B	7	I/O	Inverting Receiver Input and Inverting Driver Output
Vcc	8	Power	RS-485 Transceiver Power Supply

Limit Parameters

Exceeding the absolute maximum rating may result in permanent damage to the device, and prolonged operation at the absolute maximum rating may affect the reliability of the device.

Name	Symbol	Notes	Min.	Max.	Unit
Positive Supply	Vcc		-0.3	7	V
Control Input Voltage	$\overline{RE}$,DE		-0.3	Vcc+0.3	V
Drive Input Voltage	DI		-0.3	Vcc+0.3	V
Drive Output Voltage	A,B		-8	14	V
Reverse Input Voltage	A,B		-8	14	V
Reverse Output Voltage	RO		-0.3	Vcc+0.3	V
Operating Temperature Ranges	T_a		-40	85	℃
Storage Temperature Range	T_{stg}		-60	150	℃

Electrostatic Protection

Human Body Model (HBM) testing in accordance with EIA/JESD22-A114-B HBM

Test Parameters			Value	Unit
Voltage of Electro-Static Discharge (V_{ESD})	Human Body Model (HBM)	Pin A, B to GND	±15	kV
		Other Pins	±8	kV
	Charged-DeviceModel (CDM)	All Pins	±2	kV

Electrical Parameters

(Vcc = +3.3V to +5V, $T_A = T_{MIN}$ to T_{MAX}, unless otherwise noted, typical at 3.3V and +5V, ambient temperature +25°C.)

Parameters	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power Supply						
Supply Voltage	Vcc		3	5	5.5	V
Input Circuit Current	Icc	Receiving Mode $\overline{RE}$ = 0; DE = 0; Vcc=5V		240	650	uA
		Transmitting $\overline{RE}$ = 1; DE = 1; Vcc = 5V		270	750	uA
		Receiving Mode $\overline{RE}$ =0;DE=0; Vcc=3.3V		250	650	uA
		Transmitting Mode $\overline{RE}$ =1;DE=1;Vcc=3.3V		280	750	uA
Cut-off Current	Ishdn	$\overline{RE}$ =Vcc,DE=0, Vcc =3.3V		0.2	10	uA
		$\overline{RE}$ =Vcc, DE=0, Vcc =5V		0.2	10	uA
Logic						
Input a Logic-high Input Voltage	V_{IH}	DE,DI,$\overline{RE}$	2.0			V
Input a Logic-low Input Voltage	V_{IL}	DE,DI,$\overline{RE}$			0.8	V
DI Input Voltage Hysteresis	V_{HYS}	-7V≤V_{CM}≤12V	10	30		mV
Receiving						
Three-phase Current	I_{OZR}	0.4V<V_O<2.4V			±1	uA
Short Circuit Current	I_{OSR}	0V≤V_O≤Vcc	±8		±90	mA
Output High Voltage	V_O	V_A=2.8V, V_B=2.5V, I_{R0}=8mA	Vcc- 1.5			V
Output Low Voltage	V_{OL}	V_A =2.5V, V_B =2.8V,I_{R0}=-8mA			0.4	V
Input Impedance	R_{IN}	-7V≤V_{CM}≤12V	96			kΩ
Differential Threshold Voltage	V_{TH}		-200		-50	mV
Input Hysteresis Voltage	ΔV_{TH}	-7V≤V_{CM}≤12V		25		mV
Transmitting						
Output Voltage (no load)	V_{OD1}		3		5.5	V
Output Voltage	V_{OD2}	R_L = 54 Ω, Vcc = 5 V	1.5		Vcc	V
Voltage Magnitude Variation	ΔV_{OD}	R_L = 54 Ω			0.2	V
Common Mode Voltage	V_{OC}	R_L = 54 Ω			3	V
Common-mode Voltage Variation	ΔV_{OC}	R_L = 54 Ω			0.3	V
Short Circuit Current	I_{OSD}	Short Circuit to Low -7-0V	-250			mA

Switching Characteristics parameters

(Vcc = +3.3V to +5V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted, typical at 3.3V and +5V, ambient temperature +25°C.)

Parameters	Symbol	Conditions	Min.	Typ.	Max.	Units
Transmitting						
Maximum Data Rate	f_{MAX}			15		Mbps
Differential Output Time Delay	t_{DD}	RL=60Ω/ Figure 3		20	40	ns
Differential Output Conversion Time	t_{TD}	RL=60Ω/ Figure 3		12	28	ns
Driver Output Time Delay from Low to High	t_{PLH}	RL=27Ω/ Figure 4		20	40	ns
Driver Output Time Delay from High to Low	t_{PHL}	RL=27Ω/ Figure 4		20	40	ns
$\|t_{plh} - t_{phl}\|$ Output Time Delay	t_{PDS}	RL=27Ω/ Figure 4		1	8	ns
Output Enable and Shutdown Times						
Driver Output Enable to a Logic-low	t_{PZL}	RL=110Ω/ Figure 6			55	ns
Driver Output Enable to a Logic-high	t_{PZH}	RL=110Ω/ Figure 5			55	ns
Driver Output from Shutdown to a Logic-high	t_{PHZ}	RL=110Ω/ Figure 5			85	ns
Driver Output from Shutdown to a Logic-low	t_{PLZ}	RL=110Ω/ Figure 6			85	ns
Driver Output Enable Time from Shutdown to a Logic-low	t_{PSL}	RL=110Ω/ Figure 6		20	100	ns
Driver Output Enable Time from Shutdown to a Logic-high	t_{PSH}	RL=110Ω/ Figure 5		20	100	ns
Receiving						
Shutdown Time	t_{SHDN}		50		300	ns
Receiver Delay Time from Low to High	t_{RPLH}	VID=0 to 3.0V/ CL=15pF/ Figure 7		60		ns
Receiver Delay Time from High to Low	t_{RPHL}	VID=0 to 3.0V/ CL=15pF/ Figure 7		60		ns
|Trplh -Trphl| Delay Times	t_{RPDS}	VID=0 to 3.0V/ CL=15pF/ Figure 7		3	10	ns
Output Enable Time to Low	t_{PRZL}	CL=15pF/ Figure 8		100	300	ns
Output Enable Time to High	t_{PRZH}	CL=15pF/ Figure 8		100	300	ns
Output Shutdown to High	t_{PRHZ}	CL=15pF/ Figure 8		25	55	ns
Output Shutdown to Low	t_{PRLZ}	CL=15pF/ Figure 8		25	55	ns
Output Enable Time from Shutdown to Low	t_{PRSL}	CL=15pF/ Figure 8		100	300	ns
Output Enable Time from Shutdown to High	t_{PRSH}	CL=15pF/ Figure 8		100	300	ns

Communication Function Table

Table 1: Transmitting

Inputs			Outputs		Mode
$\overline{RE}$	DE	DI	B	A	
X	1	1	0	1	Normal.
X	1	0	1	0	Normal.
0	0	X	High-Z	High-Z	Normal l
1	0	X	High-Z	High-Z	Shutdown

Table 2: Receiving

Inputs			Outputs	Mode
$\overline{RE}$	DE	A, B	RO	
0	X	>-50mV	1	Normal
0	X	<-200mV	0	Normal
0	X	Input Open	1	Normal l
1	0	X	High-Z	Shutdown

Test Circuits and Typical Circuits

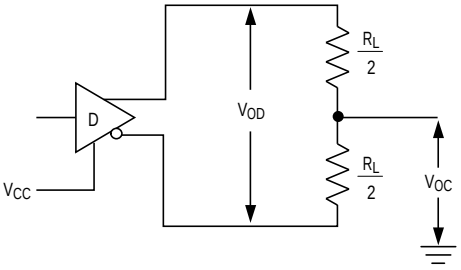


Figure 1 Transmitting V_{OD} and V_{OC}

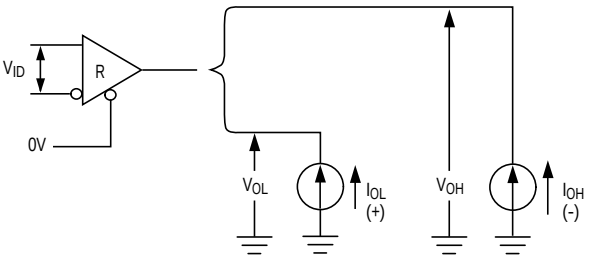
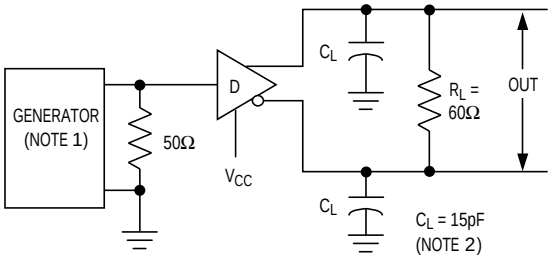


Figure 2 Receiving V_{OH} and V_{OL}



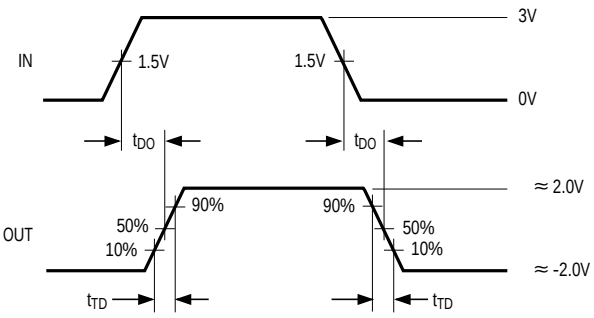
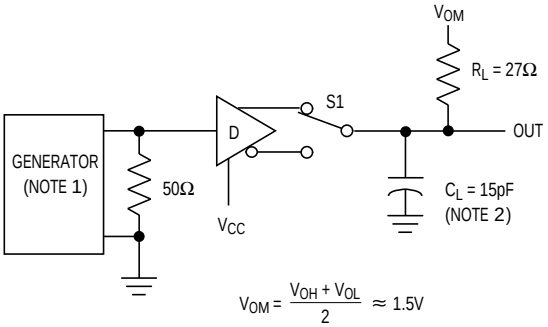


Figure 3. Differential Output Delay and Conversion Time



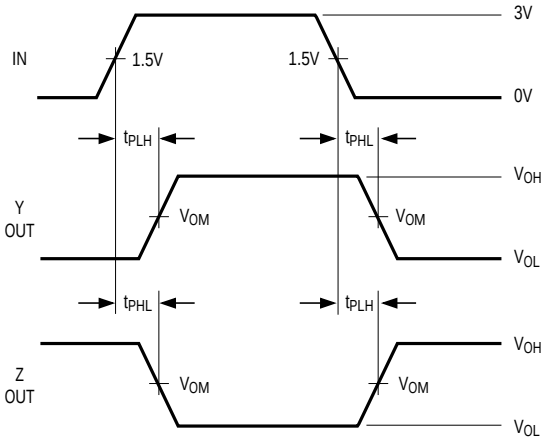
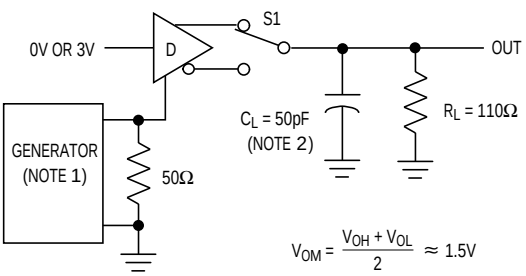


Figure 4 Transmission Delay Time



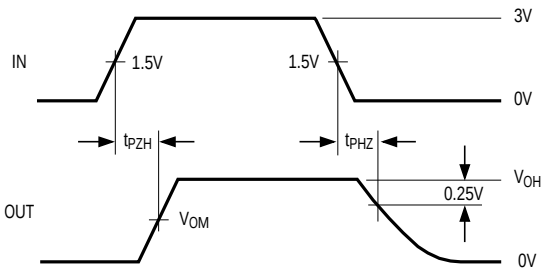


Figure 5. Enable and Shutdown Times (t_{PZH}, t_{PSH}, t_{PHZ})

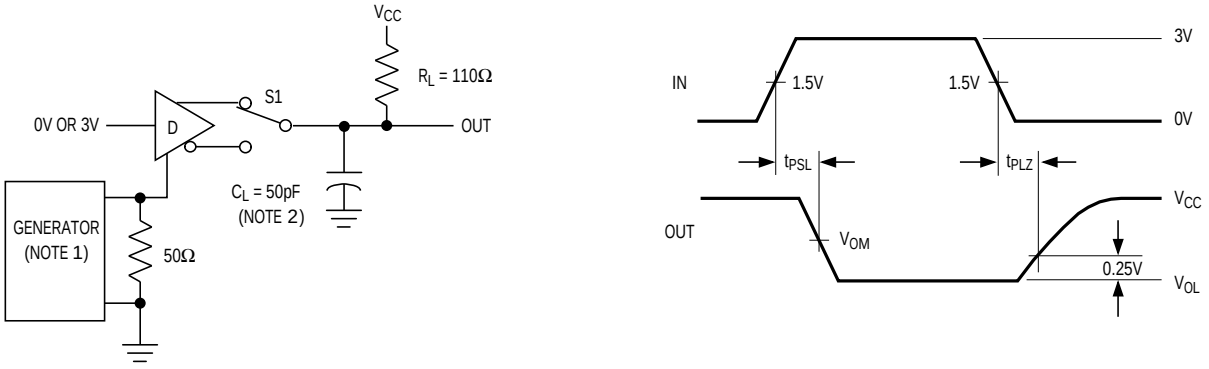


Figure 6. Enable and Shutdown Times (t_{PZL}, t_{PSL}, t_{PLZ})

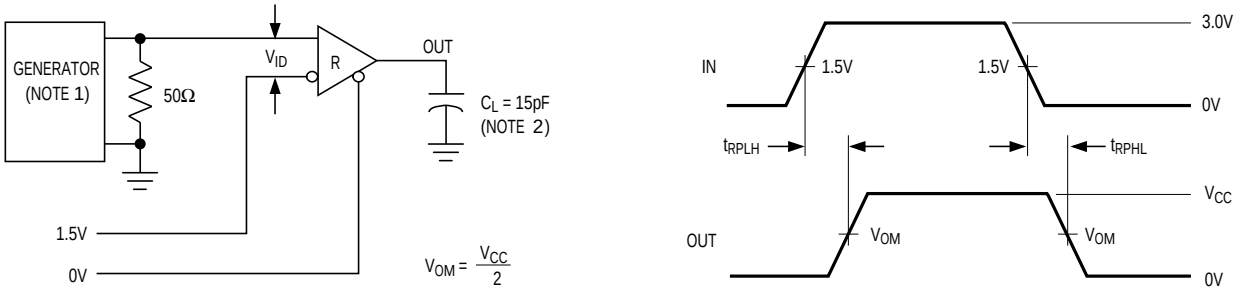


Fig. 7 Receiving Transmission Delay

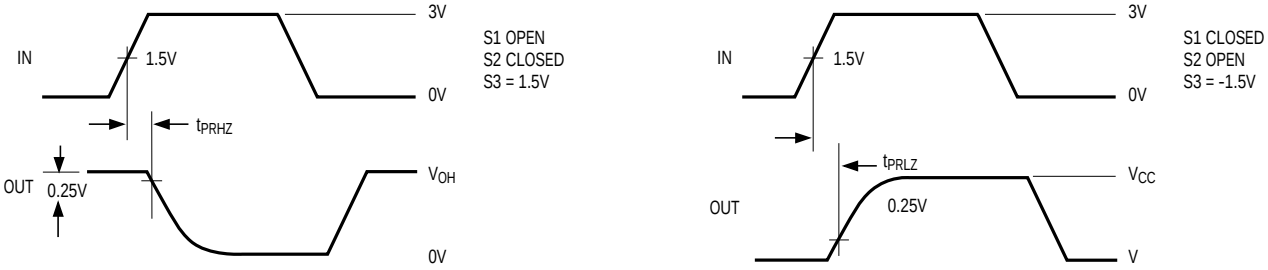


Figure 8 Receiving OPEN and CLOSE Times

Note 1: The input pulse is supplied by a generator with the following characteristics: PRR = 250kHz, 50% duty cycle, $t_r \le 6.0$ns, $Z_O = 50\Omega$.
Note 2: C_L includes probe and stray capacitance.

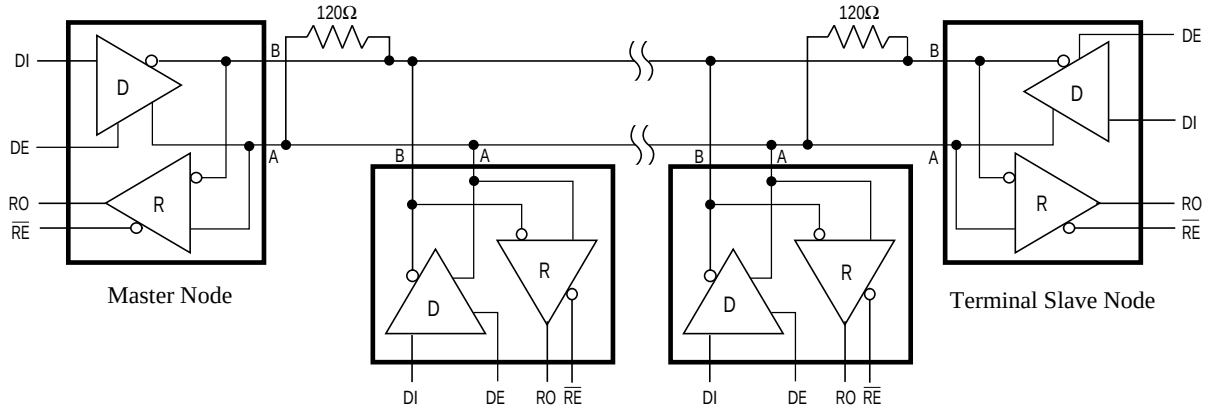


Figure 9 Typical Half-duplex RS-485 Network Application

Detailed Function Description

The HMAX3485 series is a low-power transceiver for RS-485 communication network and can support data transmitting rates up to 15 Mbps. All components are half duplex, including the Drive Enable (DE) and Receiver Enable (RE) pins. When powered off, the outputs of driver and receiver are high impedance.

ESD Protection

The HMAX3485 A B pins are particularly susceptible to ESD shocks because they are typically as external pins in products. Human actions like simply touching the pins or other actions can result in ESD problems.

Though HMAX3485 itself already has good ESD capabilities, additional ESD protection devices are suggested to be added between the external A pin and B pin to enhance its performance.

Low Power and Shutdown Mode

Low power shutdown mode is initiated by turning $\overline{RE}$ up and turning DE down. When powered off, the device typically draws only 1uA of supply current. $\overline{RE}$ and DE can be driven simultaneously. When $\overline{RE}$ in high and DE are less than 50ns, the components are guaranteed to continue. If the input is in this state for at least 300ns, the components are guaranteed to close. From the switching characteristics table, if the Enable Times t_{PZH} and t_{PZL} is not in a low power shutdown state and the component to start the enable times is turned off, Time of enabling the driver and receiver from low power off mode (t_{PSH}, t_{PSL}) takes longer than that of enabling them from disabled mode (t_{PZH}, t_{PZL}).

Bus Supports 256-node Transceiver

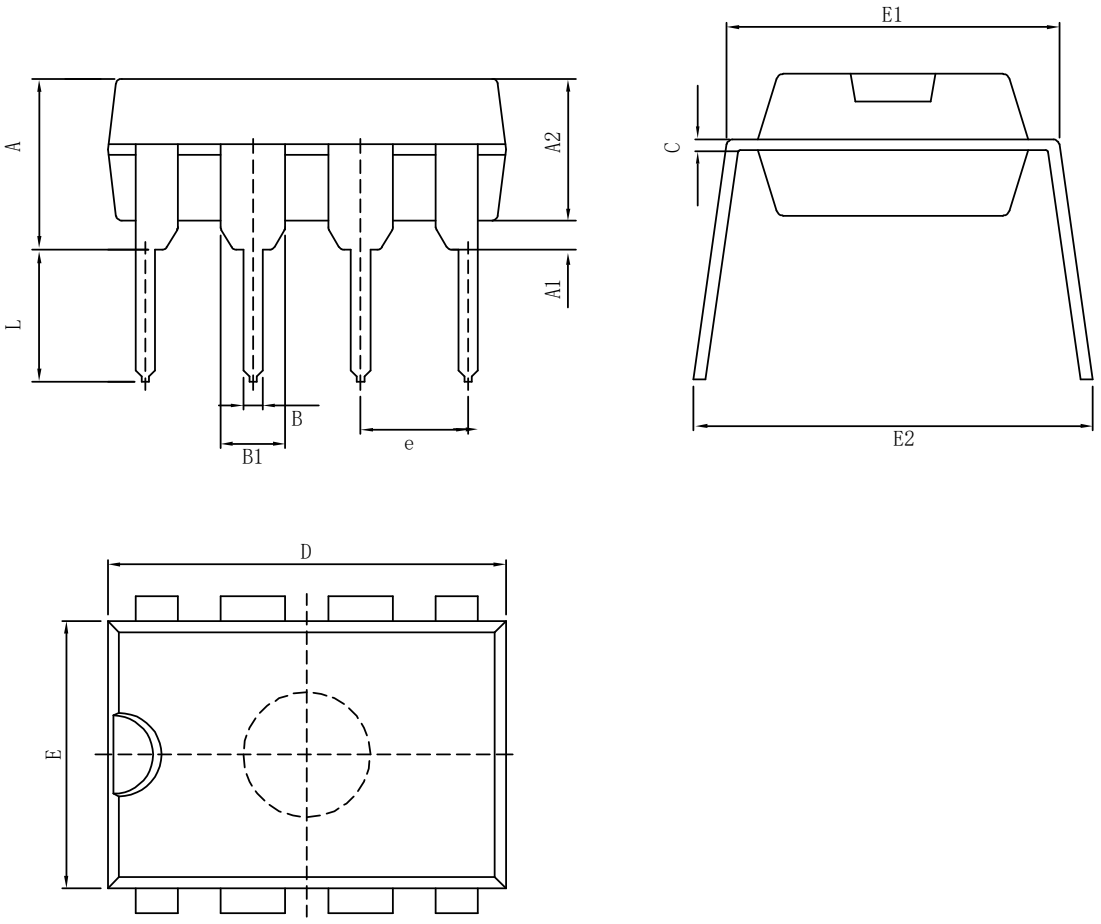
The standard RS-485 receiver has an input impedance of 12kΩ (one unit load), and the standard driver can drive up to 32 unit loads. The HMAX3485 transceiver has a 1/8 unit load receiver with input impedance (96kΩ), allowing 256 transceivers to be connected in parallel on a single communication line. Any combination of these devices and/or other RS-485 transceivers with totaling 32 unit loads or less can be connected to the line.

Output Protection

The output protection mechanism can prevent excessive output current and power loss due to faults or bus contention. First, the folded current limit on the output stage can provide immediate short-circuit protection over the entire common-mode voltage range. Second, a thermal shutdown circuit can force the driver output to a high impedance state if the mold temperature becomes too high.

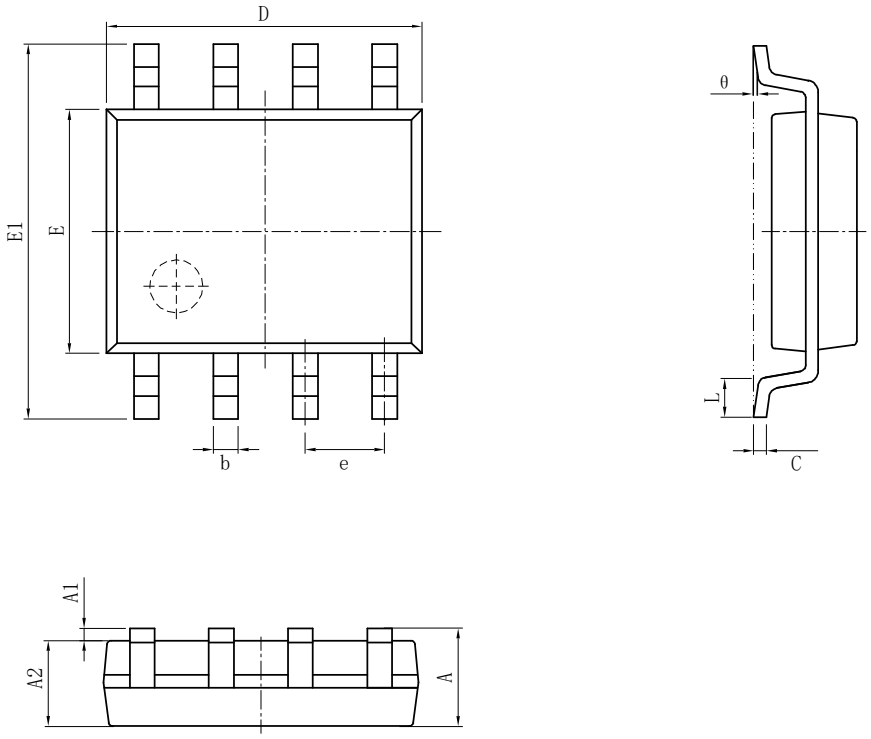
Package Information

DIP-8



Size / Symbol	Dimensions In Millimeters		Size / Symbol	Dimensions In Inches	
	Min(mm)	Max(mm)		Min(in)	Max(in)
A	3.710	4.310	A	0.146	0.170
A1	0.510		A1	0.020	
A2	3.200	3.600	A2	0.126	0.142
B	0.380	0.570	B	0.015	0.022
B1	1.524(BSC)		B1	0.060(BSC)	
C	0.204	0.360	C	0.008	0.014
D	9.000	9.400	D	0.354	0.370
E	6.200	6.600	E	0.244	0.260
E1	7.320	7.920	E1	0.288	0.312
e	2.540(BSC)		e	0.100(BSC)	
L	3.000	3.600	L	0.118	0.142
E2	8.400	9.000	E2	0.331	0.354

SOP-8



Size / Symbol	Dimensions In Millimeters		Size / Symbol	Dimensions In Inches	
	Min(mm)	Max(mm)		Min(in)	Max(in)
A	1.350	1.750	A	0.053	0.069
A1	0.100	0.250	A1	0.004	0.010
A2	1.350	1.550	A2	0.053	0.061
b	0.330	0.510	b	0.013	0.020
c	0.170	0.250	c	0.006	0.010
D	4.700	5.100	D	0.185	0.200
E	3.800	4.000	E	0.150	0.157
E1	5.800	6.200	E1	0.228	0.224
e	1.270(BSC)		e	0.050(BSC)	
L	0.400	1.270	L	0.016	0.050
θ	0°	8°	θ	0°	8°

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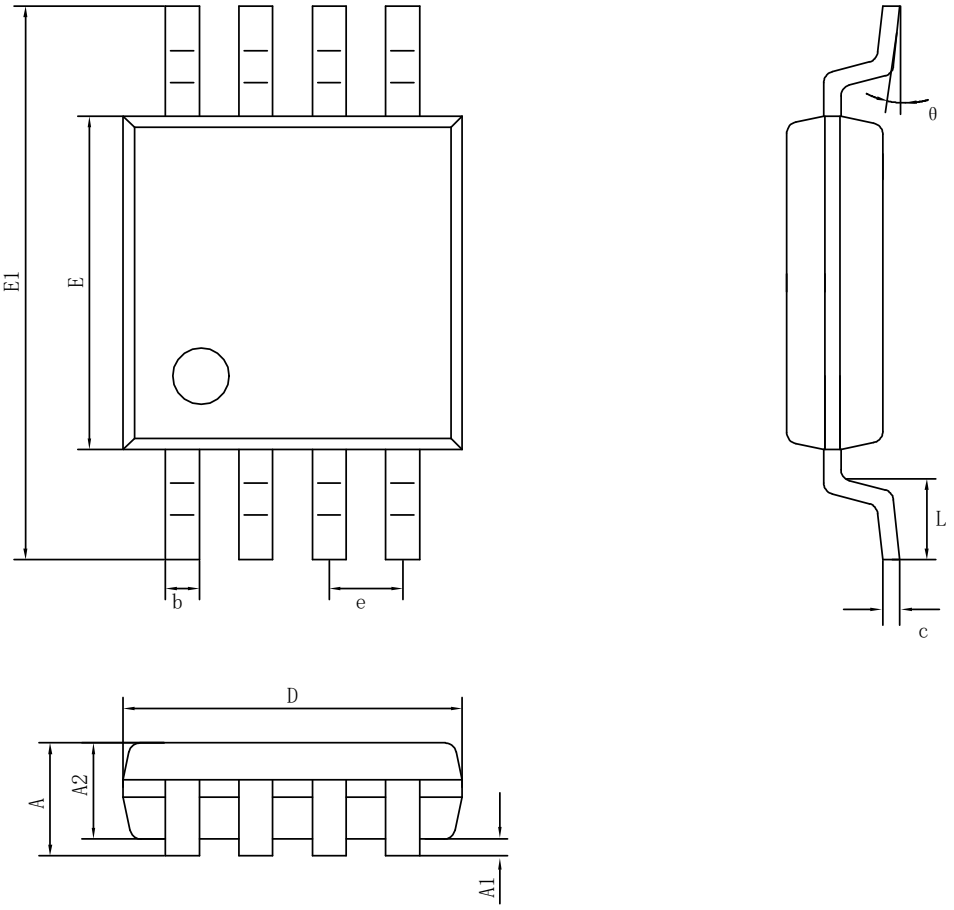

Size / Symbol	Dimensions In Millimeters		Size / Symbol	Dimensions In Inches	
	Min(mm)	Max(mm)		Min(in)	Max(in)
A	0.820	1.100	A	0.320	0.043
A1	0.020	0.150	A1	0.001	0.006
A2	0.750	0.950	A2	0.030	0.037
b	0.250	0.380	b	0.010	0.015
c	0.090	0.230	c	0.004	0.009
D	2.900	3.100	D	0.114	0.122
e	0.65（BSC）		e	0.026(BSC)	
E	2.900	3.100	E	0.114	0.122
E1	4.750	5.050	E1	0.187	0.199
L	0.400	0.800	L	0.016	0.031
θ	0°	6°	θ	0°	6°

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