



AiP485B

Low-Power 500Kbps Full Fail-Safe RS-485

Transceiver

Product Specification

Specification Revision History:

Version	Date	Description
2021-05-A1	2021-05	New



1、 General Description

The AiP485B is 3V~5.5V powered transceiver that meets the RS-485 standards for balanced communication.

This transceiver delivers at least a 2.1V differential output voltage on 5V supply condition, into the RS-485 required 54Ω load, for better noise immunity. This 500Kbps device has very low bus currents so that presents a true “1/8 unit load” to the RS-485 bus. This allows up to 256 transceivers on the network without using repeaters.

Receiver (Rx) inputs feature a “Full Fail-Safe” design, which ensures a logic high Rx output if Rx inputs are floating, shorted, or on a terminated but undriven bus.

Features:

- Wide supply voltage 3V to 5.5V
- Hot plug circuitry-Tx and Rx outputs remain three-state during power-up/power-down
- Data rate: up to 500Kbps
- Full fail-safe (open, short, terminated) receivers
- Up to 256 nodes on a bus (1/8 unit load)
- Bus-Pin Protection: ±15kV HBM protection
- Specified from -40°C to +85°C
- Packaging information: SOP8/MSOP8/DFN8

**Ordering Information:****Tube packing specifications:**

Part number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Notes
AiP485BSA8.TB	SOP8	AiP485B	100 PCS/tube	100 tube/box	10000 PCS/box	Dimensions of plastic enclosure: 4.9mm×3.9mm Pin spacing: 1.27mm
AiP485BMA8.TB	MSOP8	AiP485B	100 PCS/tube	120 tube/box	12000 PCS/box	Dimensions of plastic enclosure: 3.0mm×3.0mm Pin spacing: 0.65mm
AiP485BXA8.TB	DFN8	AiP485B	490 PCS/plate	10 plate/box	4900 PCS/box	Dimensions of plastic enclosure: 3.0mm×3.0mm Pin spacing: 0.65mm

Reel packing specifications:

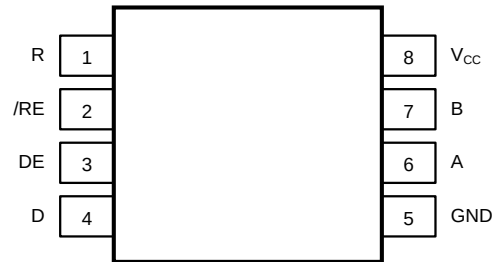
Part number	Packaging form	Marking code	Reel quantity	Boxed reel quantity	Notes
AiP485BSA8.TR	SOP8	AiP485B	4000PCS/reel	8000PCS/box	Dimensions of plastic enclosure: 4.9mm×3.9mm Pin spacing:1.27mm
AiP485BMA8.TR	MSOP8	AiP485B	5000PCS/reel	10000PCS/box	Dimensions of plastic enclosure: 3.0mm×3.0mm Pin spacing:0.65mm

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



2、Block Diagram And Pin Description

2.1、Pin Configurations



2.2、Pin Description

Pin No.	Pin Name	I/O	Description
1	R	digital output	receiver Output
2	/RE	digital input	receiver Output Enable
3	DE	digital input	driver Output Enable
4	D	digital input	driver input
5	GND	ground	ground
6	A	bus input/output	noninverting receiver input A and noninverting driver output A
7	B	bus input/output	Inverting receiver input A and Inverting driver output A
8	V _{CC}	power	power supply

2.3、Function Table

2.3.1、Driver Function Table

Input	Enable	Outputs		Description
D	DE	A	B	
Normal Mode				
H	H	H	L	actively drives bus High
L	H	L	H	actively drives bus Low
X	L	Z	Z	driver disabled
X	open	Z	Z	driver disabled by default
open	H	H	L	actively drives bus High by default

2.3.2、Receiver Function Table

Differential Input	Enable	Outputs	Description
V _{ID} =V _A -V _B	/RE	R	
Normal Mode			
V _{IT+} <V _{ID}	L	H	receive valid bus High
V _{IT-} <V _{ID} <V _{IT+}	L	/	indeterminate bus state
V _{ID} <V _{IT-}	L	L	receive valid bus Low
X	H	Z	receiver disabled
X	open	Z	receiver disabled by default
open, short, idle bus	L	H	fail-safe high output



3、Electrical Parameter

3.1、Absolute Maximum Ratings

($T_{amb}=25^{\circ}\text{C}$, All voltage referenced to GND, unless otherwise specified)

Characteristic	Symbol	Conditions	Value	Unit
supply voltage	V_{CC}	-	-0.3 to +7	V
input voltage	V_I	D, DE, /RE	-0.3 to $V_{CC}+0.3$	V
input/output voltage	$V_{I/O}$	A, B	-15 to +15	V
		A, B(transient pulse through 100 Ω)	± 100	V
		R	-0.3 to $V_{CC}+0.3$	V
short circuit duration	-	A, B	continuous	-

3.2、Recommended Operating Conditions

Characteristic	Symbol	Conditions	Value	Unit
supply voltage	V_{CC}	-	3 to 5.5	V
bus pin common mode voltage	V_{CM}	-	-7 to 12	V
High-level input voltage	V_{IH}	driver, driver enable, and receiver enable inputs	2 to V_{CC}	V
Low-level input voltage	V_{IL}	driver, driver enable, and receiver enable inputs	0 to 0.8	V
differential input voltage	V_{ID}	-	-7 to 12	V
differential load resistance	R_L	-	>54	Ω
operating temperature	T_{amb}	-	-40 to 85	$^{\circ}\text{C}$
storage temperature	T_{stg}	-	-65 to 150	$^{\circ}\text{C}$

3.3、ESD Rating

HBM Model	Value	Unit
bus pins(A,B)	± 15	kV
all other pins	± 15	kV



3.4、Electrical Characteristics

3.4.1、DC Characteristics

(T_{amb}= -40 to 85℃, V_{CC}=5V, unless otherwise specified)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit	
driver differential-output voltage magnitude	V _{OD}	R _L =60Ω@VA&VB(-7~12V) V _{CC} =4.5 to 5.5V		Figure 1B	2.1	3.5	-	V
		R _L =60Ω@VA&VB(-7~12V) V _{CC} =3.0 to 3.6V			1.5	2.2	-	V
		R _L =54Ω, V _{CC} =5V		Figure 1A	2	3.4	-	V
		R _L =54Ω, V _{CC} =3V			1.5	1.9	-	V
		R _L =100Ω, V _{CC} =5V			2.7	4.0	-	V
		R _L =100Ω, V _{CC} =3V			2	2.3	-	V
change in magnitude of driver differential-output voltage	Δ V _{OD}	R _L =54Ω, V _{CC} =5V, C _L =50pF	Figure 1A	-50	2	50	mV	
steady-stage common-mode output voltage	V _{OC(SS)}	center of two 27Ω load resistors	Figure 1A	1	V _{CC} /2	3	V	
change in differential driver common-mode output voltage	ΔV _{OC}			-	50	-	mV	
peak-to-peak driver common-mode output voltage	V _{OC(PP)}			-	500	-	mV	
differential output capacitance	C _{OD}	-		-	8	-	pF	
positive-going receiver differential-input voltage threshold	V _{IT+}	VA/VB: from -7~12V		-	-110	-40	mV	
negative-going receiver differential-input voltage threshold	V _{IT-}	VA/VB: from -7~12V		-220	-140	-	mV	
receiver differential-input voltage threshold hysteresis (V _{IT+} -V _{IT-})	V _{HYS}	-		-	30	-	mV	
logic Input High Voltage	V _{IH}	DI, DE, /RE		2	-	-	V	
logic Input Low Voltage	V _{IL}	DI, DE, /RE		-	-	0.8	V	
receiver high-level output voltage	V _{OH}	I _{OH} =-8mA		3	4.6	-	V	
receiver low-level output voltage	V _{OL}	I _{OL} =8mA		-	-	0.4	V	
driver input, driver enable	I _i	DI, DE, /RE		-5	-	5	uA	
receiver high-Z output current	I _{OZ}	V _O =0/V _{CC} , REN=V _{CC}		-1	-	1	uA	
driver short-circuit output current	I _{OS}	I _{OS} with VA/VB from -7 to 12V		-250	110	250	mA	
		Bus pin A,B short current		-	-	150	mA	
bus input current(driver disabled)	I _{IN}	V _{CC} =4.5 to 5.5 or V _{CC} =0, DE at 0V	V _I =12V	-	-	120	uA	
			V _I =-7V	-110	-	-	uA	
bus input impedance	R _A /R _B	VA=-7V, VB=12V and VA=12V, VB=-7V		96	-	-	KΩ	



supply current(quiescent)	I_{CC}	TX、RX enable	DE= V_{CC} , /RE=GND, no load;	-	650	750	uA
		TX enable, RX disable	DE= V_{CC} , /RE= V_{CC} , no load;	-	450	600	
		TX disable, RX enable	DE=GND, /RE=GND, no load;	-	400	600	
		TX disable, RX disable	DE=GND, /RE= V_{CC} , no load;	-	<0.1	2	

3.4.2、AC Characteristics

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Driver							
maximum data rate	f _{MAX}	V _{OD} ≥±1.5V, R _L =54Ω, C _L =100pF; (Figure 4)		-	-	500	Kbps
driver differential-output rise and fall times	t _r , t _f	R _L =54Ω, C _L =50pF	Figure 2	-	120	-	ns
driver propagation delay	t _{PHL} , t _{PLH}			-	180	-	ns
t _{PHL} - t _{PLH}	t _{SK(P)}			-	-	20	ns
driver disable time	t _{PHZ}	C _L =15pF	Figure 3	-	35	90	ns
	t _{PLZ}			-	50	90	ns
driver enable time	t _{PZH}	RX enable		-	160	450	ns
		RX disable		-	2600	3200	ns
	t _{PZL}	RX enable		-	140	450	ns
		RX disable		-	2600	3200	ns
Receiver							
receiver output rise and fall times	t _r , t _f	C _L =15pF	Figure 5	-	28	-	ns
receiver propagation delay time	t _{PHL} , t _{PLH}			-	80	150	ns
receiver pulse skew, t _{PHL} -t _{PLH}	t _{SK(P)}			-	-	25	ns
receiver disable time	t _{PHZ}	-		-	20	65	ns
	t _{PLZ}			-	20	65	
receiver enable time	t _{PZH}	TX enable		-	110	200	ns
		TX disable		-	2700	3200	ns
	t _{PZL}	TX enable		-	27	50	ns
		TX disable		-	2400	3200	ns



4、Testing Circuit

4.1、DC Testing Circuit

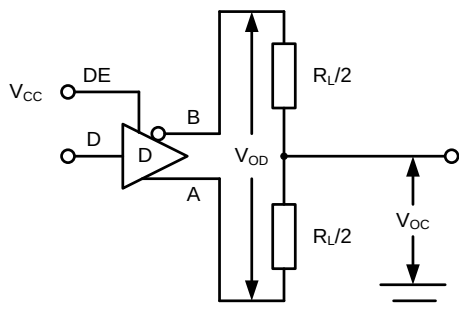
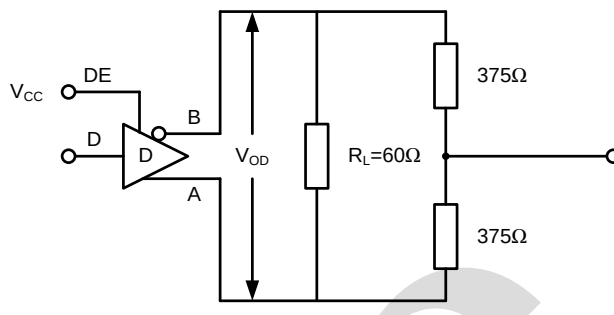
Figure 1A. V_{OD} and V_{OC} Figure 1B. V_{OD} with common mode load

Figure 1. DC driver test circuits

4.2、AC Testing Circuit

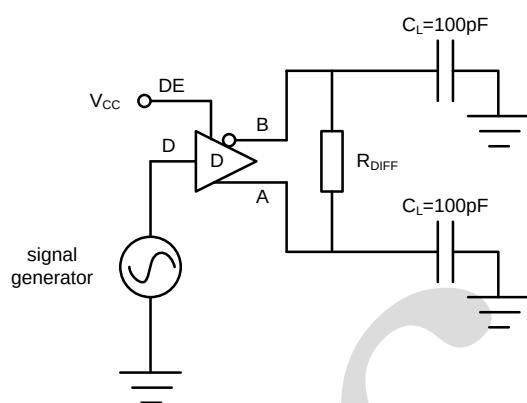


Figure 2A. test circuit

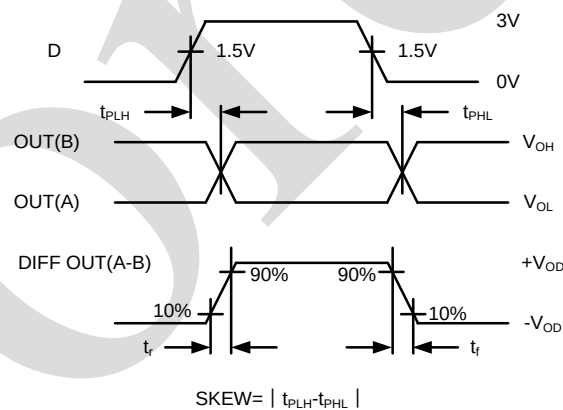


Figure 2B. measurement points

Figure 2. driver propagation delay and differential transition times

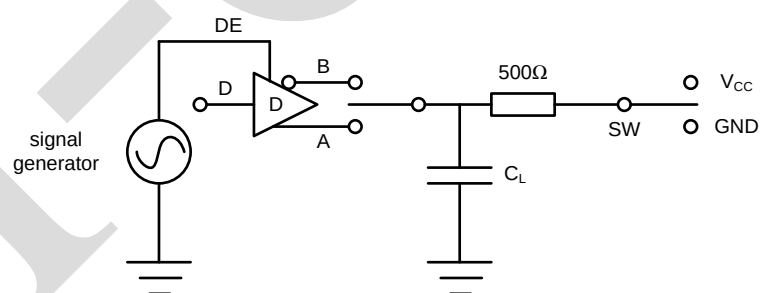


Figure 3A. test circuit

Parameter	Output	/RE	D	SW	C_L (pF)
t_{PHZ}	A/B	X	1/0	GND	15
t_{PLZ}	A/B	X	0/1	V_{CC}	15
t_{PZH}	A/B	0	1/0	GND	100
t_{PZL}	A/B	0	0/1	V_{CC}	100
$t_{PZH}(SHDN)$	A/B	1	1/0	GND	100
$t_{PZL}(SHDN)$	A/B	1	0/1	V_{CC}	100

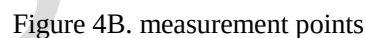
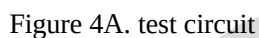
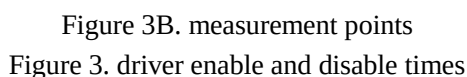


Figure 4. driver data rate

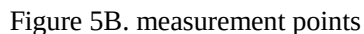
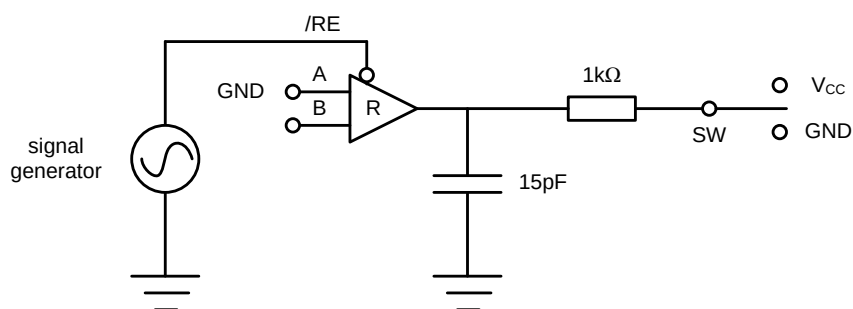


Figure 5. receiver propagation delay and data rate



Parameter	DE	A	SW
t_{PHZ}	1	+1.5V	GND
t_{PLZ}	1	-1.5V	V_{CC}
t_{PZH}	1	+1.5V	GND
t_{PZL}	1	-1.5V	V_{CC}
$t_{PZH(SHDN)}$	0	+1.5V	GND
$t_{PZL(SHDN)}$	0	-1.5V	V_{CC}

Figure 6A. test circuit

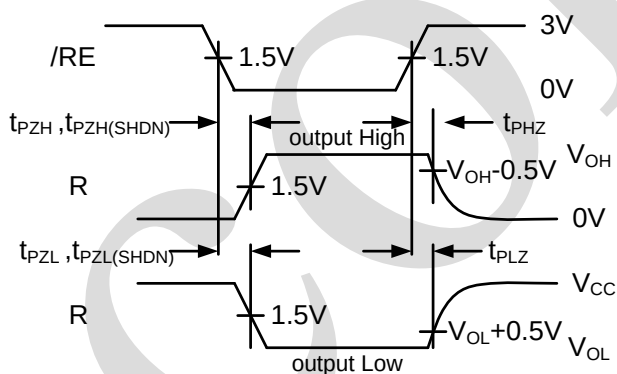


Figure 6B. measurement points

Figure 6. receiver enable and disable times



5、Characteristic Curve

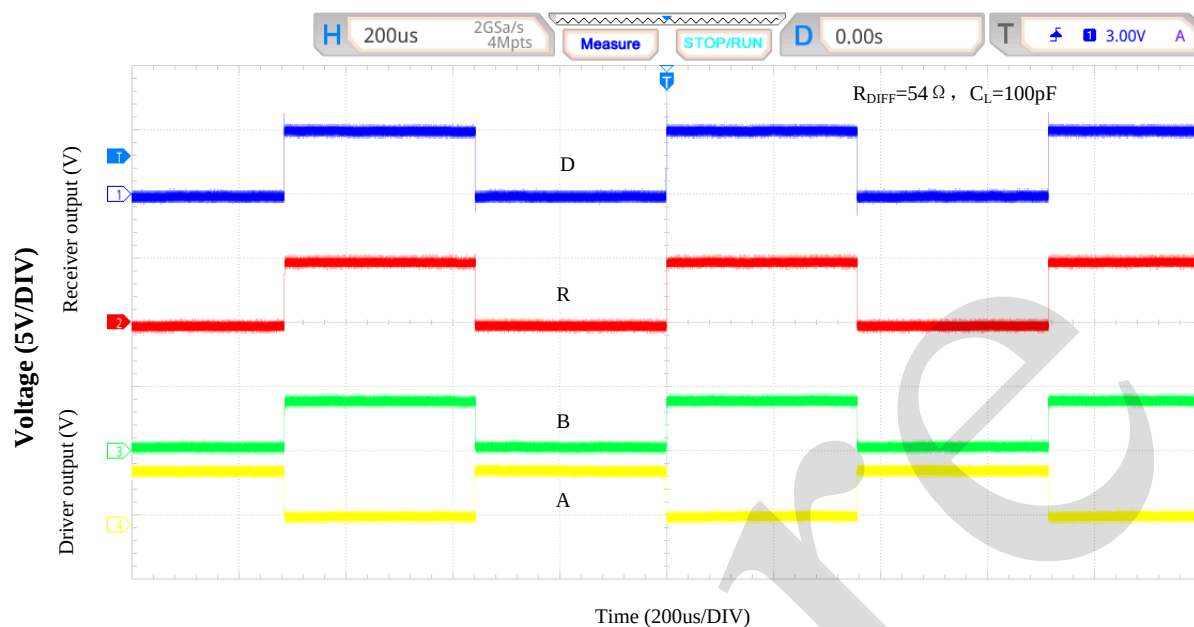


Figure 7. driver and receiver waveforms

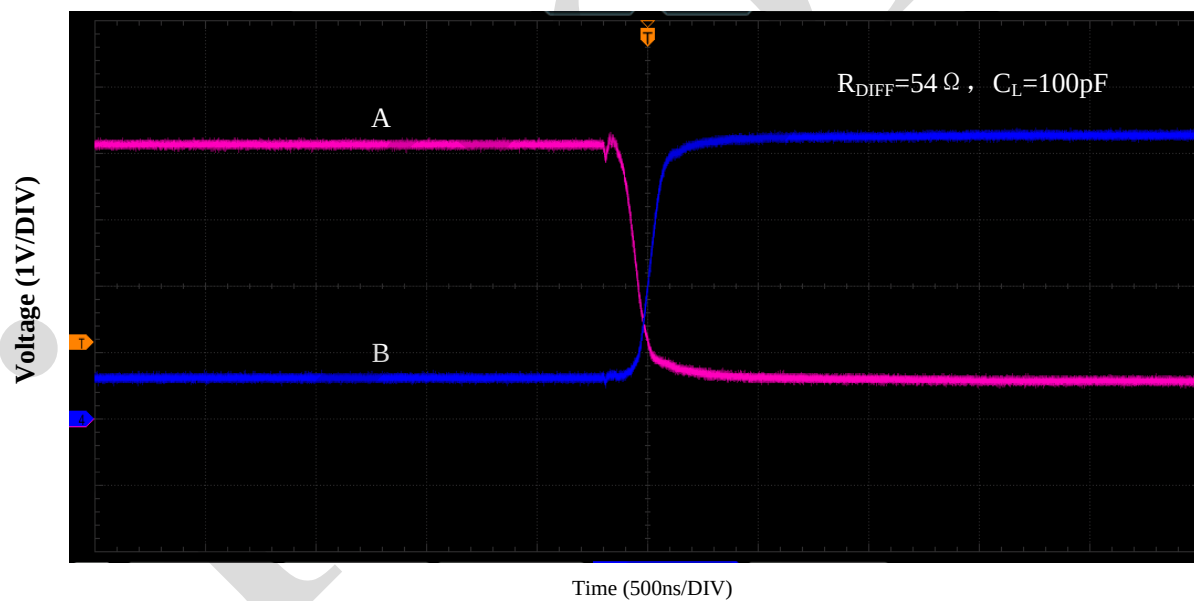


Figure 8. driver waveforms



6、Function Description

RS-485 is differential (balanced) data transmission standards used for long haul or noisy environments. RS-485 is a true multipoint standard, which allows up to 32 one unit load devices (any combination of drivers and receivers) on each bus. To allow for multipoint operation, the RS-485 specification requires that drivers must handle bus contention without sustaining any damage. Another important advantage of RS-485 is the extended common mode range (CMR), which specifies that the driver outputs and receiver inputs withstand signals that range from +12V to -7V. RS-485 is intended for runs as long as 4000', so the wide CMR is necessary to handle ground potential differences, as well as voltages induced in the cable by external fields.

Twisted pair is the cable of choice for RS-485 networks. Twisted pair cables tend to pick up noise and other electromagnetically induced voltages as common mode signals, which are effectively rejected by the differential receiver in this IC.

Proper termination is imperative to minimize reflections. In point-to-point, or point-to-multipoint (single driver on bus) networks, the main cable should be terminated in its characteristic impedance (typically 120Ω) at the end farthest from the driver. In multi-receiver applications, stubs connecting receivers to the main cable should be kept as short as possible. Multipoint (multi-driver) systems require that the main cable be terminated in its characteristic impedance at both ends. Stubs connecting a transceiver to the main cable should be kept as short as possible.

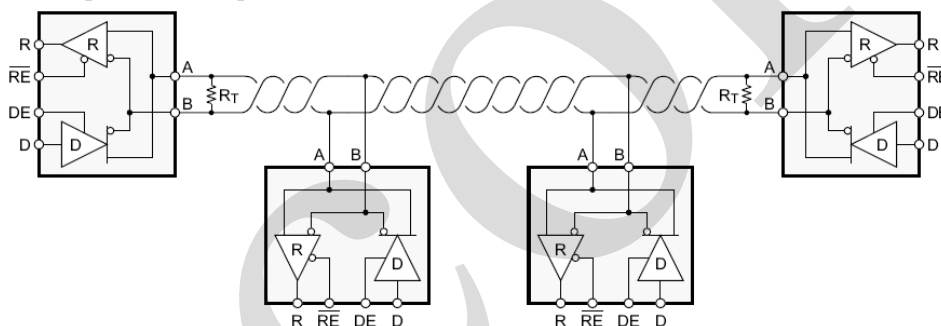


Figure 9. Typical Application

6.1、Receiver (Rx) Features

AiP485B utilize a differential input receiver for maximum noise immunity and common mode rejection. Input sensitivity is better than $\pm 200\text{mV}$, as required by the RS-485 specifications. Rx outputs feature high drive levels to ease the design of optically coupled isolated interfaces.

Receiver input resistance of 100kΩ is eight times the RS-485 “Unit Load (UL)” requirement of 12kΩ minimum. Thus, these products are known as UL/8 transceivers, and there can be up to 256 of these devices on a network while still complying with the RS-485 loading specification. Rx inputs function with common mode voltages as great as $\pm 7\text{V}$ outside the power supplies (i.e., +12V and -7V), making them ideal for long networks where induced voltages are a realistic concern.

6.2、Driver (Tx) Features

AiP485B driver is a differential output device that delivers at least 2.1V across a 54Ω load (RS-485). The drivers feature low propagation delay skew to maximize bit width, and to minimize EMI, and all drivers are three-stable via the active high DE input.



6.3、Full Fail-Safe

The receiver includes a “full fail-safe” function that guarantees a high level receiver output if the receiver inputs are unconnected (floating), shorted together, or connected to a terminated bus with all the transmitters disabled. The receiver easily meets the data rates supported by the corresponding driver, and the receiver output is three-stable via the active low /RE input.

6.4、Hot Plug Function

When a piece of equipment powers up, there is a period of time where the processor or ASIC driving the RS-485 control lines (DE, /RE) is unable to ensure that the RS-485 Tx and Rx outputs are kept disabled. If the equipment is connected to the bus, a driver activating prematurely during power-up may crash the bus. To avoid this scenario, the AiP485B devices incorporate a “Hot Plug” function. Circuitry monitoring V_{CC} ensures that, during power-up and power-down, the Tx and Rx outputs remain disabled, regardless of the state of DE and /RE, if V_{CC} is less than $\sim 2.5V$. This gives the processor/ASIC a chance to stabilize and drive the RS-485 control lines to the proper states.

6.5、Detailed Design Procedure

In order to protect bus nodes against high-energy transients, the implementation of external transient protection devices is necessary.

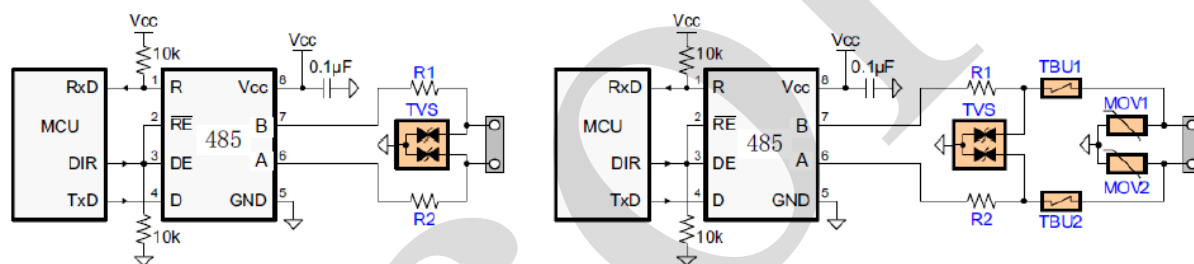


Figure 10. Transient Protections Against ESD, EFT, and Surge Transients

The left circuit shown in Figure 10 provides surge protection of $\geq 500V$ transients, while the right protection circuits can withstand surge transients of 5 KV. Table 1 shows the associated Bill of Materials.

Table 1. Bill of Materials

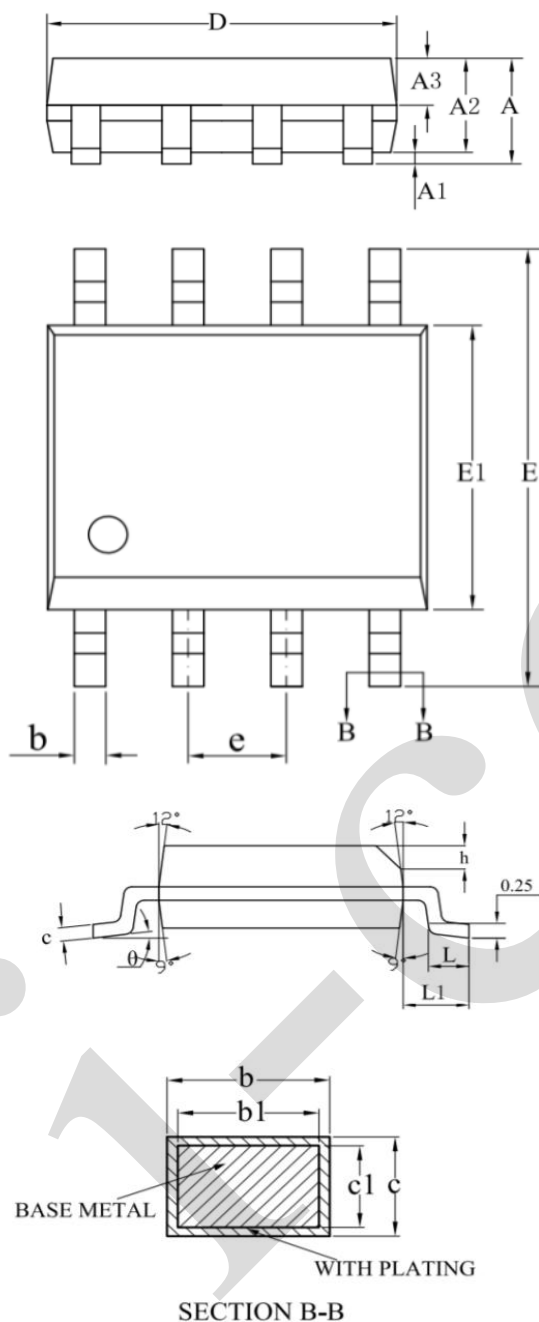
Device	Function	Order Number	Manufacturer
485	5-V, 10Mbps RS-485 Transceiver	AiP485B	i-core
R1,R2	10-Ω, Pulse-Proof Thick-Film Resistor	CRCW0603010RJNEAHP	Vishay
TVS	Bidirectional 400-W Transient Suppressor	CDSOT23-SM712	Bourns
TBU1,TBU2	Bidirectional	TBU-CA-065-200-WH	Bourns
MOV1,MOV2	200mA Transient Blocking Unit 200-V, Metal- Oxide Varistor	MOV-10D201K	Bourns



7、Package Information

7.1、SOP8

SOP8(SO1R)

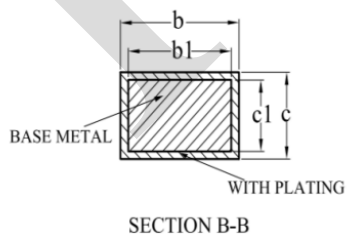
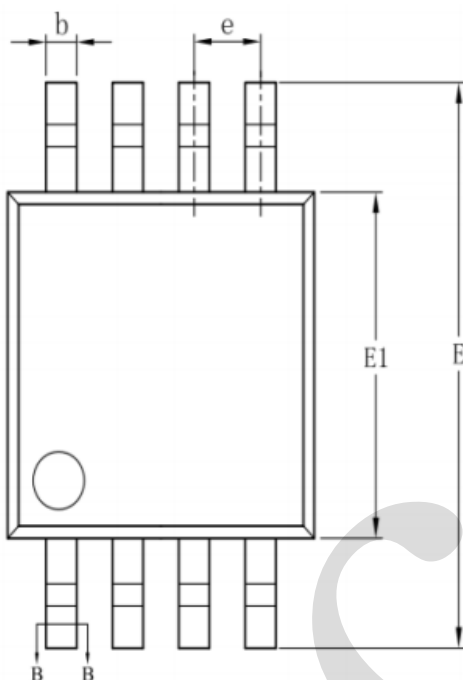
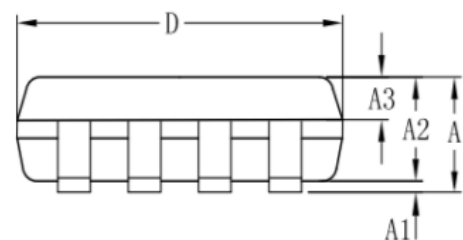


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.10	—	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	—	0.47
b1	0.38	0.41	0.44
c	0.20	—	0.24
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	—	0.50
L	0.50	—	0.80
L1	1.05REF		
θ	0	—	8°

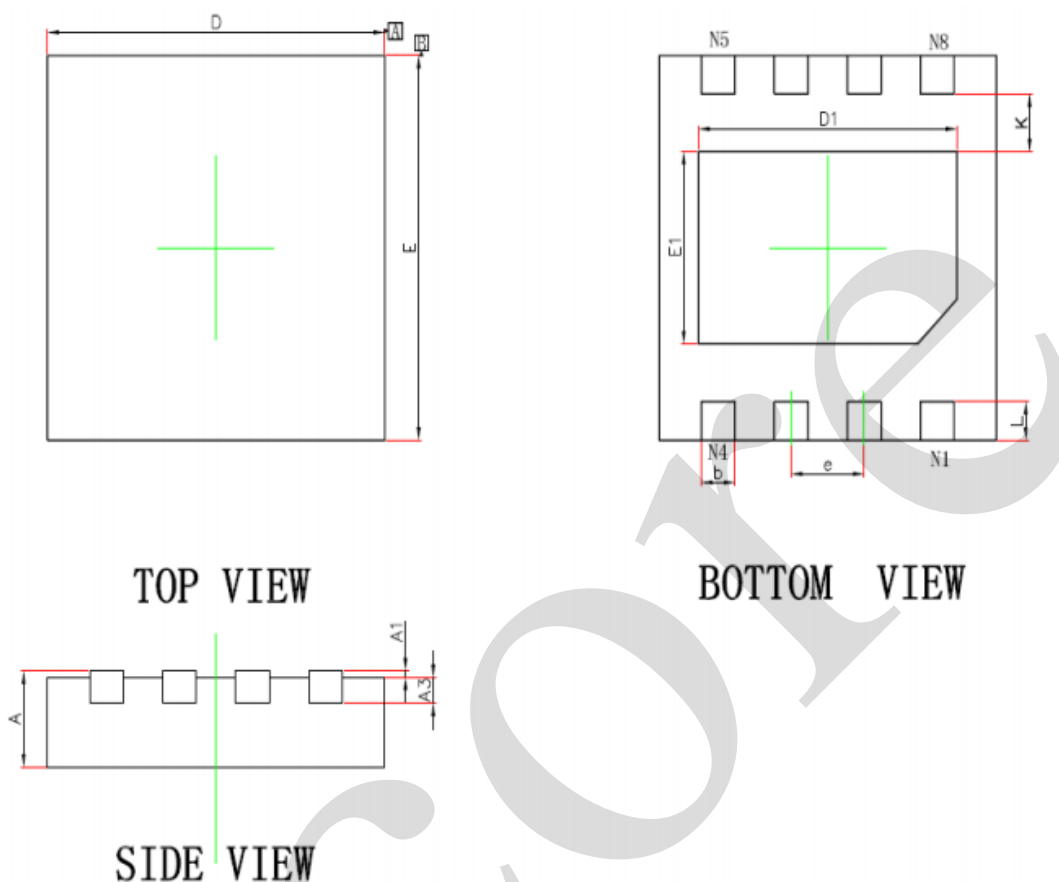


7.2、MSOP8

MSOP8(VS1R)



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.10
A1	0.05	—	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.28	—	0.36
b1	0.27	0.30	0.33
c	0.15	—	0.19
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.65BSC		
L	0.40	—	0.70
L1	0.95REF		
θ	0	—	8°

**7.3、DFN8****DFNWB3X3-8L-F(DF6R)**

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	NOM.	Min.	NOM.
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	3.000BSC.		0.118BSC.	
E	3.000BSC.		0.118BSC.	
D1	2.200	2.400	0.087	0.094
E1	1.400	1.600	0.055	0.063
k	0.250MIN.		0.010MIN.	
b	0.250	0.350	0.010	0.014
e	0.650TYP.		0.026TYP.	
L	0.224	0.376	0.009	0.015



8、Statements And Notes

8.1、The name and content of Hazardous substances or Elements in the product

Part name	Hazardous substances or Elements									
	Lead and lead compounds	Mercury and mercury compounds	Cadmium and cadmium compounds	Hexavalent chromium compounds	Polybrominated biphenyls	Polybrominated biphenyl ethers	Dibutyl phthalate	Butylbenzyl phthalate	Di-2-ethylhexyl phthalate	Diisobutyl phthalate
Lead frame	○	○	○	○	○	○	○	○	○	○
Plastic resin	○	○	○	○	○	○	○	○	○	○
Chip	○	○	○	○	○	○	○	○	○	○
The lead	○	○	○	○	○	○	○	○	○	○
Plastic sheet installed	○	○	○	○	○	○	○	○	○	○
explanation	○: Indicates that the content of hazardous substances or elements in the detection limit of the following the SJ/T11363-2006 standard. ×: Indicates that the content of hazardous substances or elements exceeding the SJ/T11363-2006 Standard limit requirements.									

8.2、Notion

Recommended carefully reading this information before the use of this product;

The information in this document are subject to change without notice;

This information is using to the reference only, the company is not responsible for any loss;

The company is not responsible for the any infringement of the third party patents or other rights of the responsibility.