



钜地半导体  
Tudi Semiconductor

## Product Specification

TUDI-MAX487E

Low-Power, Slew-Rate-Limited RS485/RS422 Transceivers

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## FEATURES

- Thermal shutdown protection ;
- Low-Current Shutdown Mode ;
- True Fail-Safe Receiver ;
- Excellent noise immunity ;
- 250kbps in Electrically Noisy Environments ;
- Hot-Swap Input Structures on DE and/RE ;
- 5V Power Supply, Half-duplex ;
- allows up to 32 transceivers on the bus ;
- Short-circuit protection ;

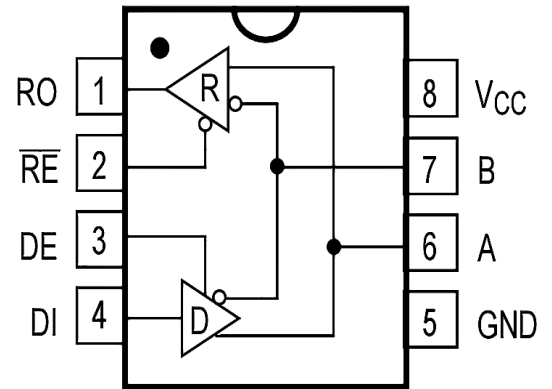


Figure 1. Pin Diagram

## Description

The MAX487E is a low-power, RS-485 and RS-422 transceiver for harsh environments. driver output and receiver input is protected with  $\pm 15\text{kV}$  ESD (electrostatic discharge) protection that will not latch up. These parts contain one driver and one. The MAX487E has a reduced rise-rate driver that minimizes EMI and reduces reflections due to cable improper termination, thus allowing error-free data transmission up 250kbps. These transceivers consume only  $120\mu\text{A}$  of supply current with the drivers disabled and the line fully loaded. Additionally, the MAX47E has a low-current shutdown mode in which they only consume  $0.5\mu\text{A}$ . All parts operate from a single 5V power supply. The short-uit current is limited, and thermal shutdown circuitry is protected, forcing the outputs into a high-impedance state to prevent excessive power dissipation. The receiver inputs have a failsafe feature that guarantees the output to be logic high if they are open . The MAX487E has a quarter-unit load receiver input impedance, allowing up to 18 transceivers on the bus. The MAX487E is designed for half-duplex applications.

## FUNCTION TABLES

TRANSMITTING						RECEIVING			
CTR	/RE	X	X	0	1	0	0	0	1
	DE	1	1	0	0	X	X	X	X
INPUTS	DI	1	0	X	X				
	A-B					$\geq -10\text{mV}$	$\leq -200\text{mV}$	Open/shorted	X
OUTPUTS	A	H	L	Z					
	B	L	H	Z					
	RO					H	L	H	Z

X:Don't care;Z:high impedance.



## Pin description

Pin Number	Pin Name	FUNCTION
1	RO	Receiver Output.When enabled,ifA-B $\geq$ -10mV,then RO=high.IfA-B $\leq$ -200 mV,then RO=low
2	/RE	Receiver Output Enable.Alow level enables the RO;a high level places it in a high impedance state.
3	DE	Driver Output Enable.A high level enables the driver differential outputs,Pin A and Pin B;a low level places the driver in a high impedance state.
4	DI	Driver Input.When the driver is enabled,a logic low on DI forces Pin A low and Pin B high;a logic high on DI forces PinA high and Pin B low.
5	GND	Ground Connection (0V).
6	A	No inverting Receiver Input A/Driver Output A
7	B	Inverting Receiver Input B/Driver Output B.
8	VCC	Power Supply

## Parameter limit

PARAMETER	Symbol	Value	Unit
CTR Port	/RE,DE,DI	-0.3~VCC+0.3	V
Driver Output Voltage	A、B	-7~13	V
Receiver Output Voltage	RO	-0.3~VCC+0.3	V
Supply Voltage	VCC	+7	V
Continuous Power Dissipation	MSOP8.SOP8.DIP8	830	mW
Soldering Temperature (reflow)		300	°C
Storage Temperature Range		-60~150	°C
Temperature Range		-40~85	°C

Stresses beyond those listed under “Parameter limit” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability



PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SWITCHING CHARACTERISTICS OF RECEIVER						
Receiver Enable to Output Low	tRZL	CL=100 pF, S1closed		20	50	ns
Receiver Enable to Output High	tRZH	CL=100 pF, S2 closed		20	50	ns
Receiver Disable Time from Low	tRLZ	CL=100 pF,		20	50	ns
Receiver Disable Time from High	tRHZ	CL=100pF, S2 closed		20	50	ns
Receiver Propagation Delay (low to high)	tRPLH	Fig 7 and 8 VD≥2.0V;  Rise and fall time VID≤15ns		50	200	ns
Receiver Propagation Delay (high to low)	tRPHL			50	200	ns
tRPLH-tRPHL	tsKEW2			13	15	ns
SWITCHING CHARACTERISTICS OF DRIVER						
Driver Enable to Output High	tDzH	CL=100 pF, S1 closed (Fig 5,6)			70	ns
Driver Enable to Output Low	tDzL				70	ns
Driver Disable Time from Low	tDLz	CL=15 pF, S2 closed (Fig 5,6)			70	ns
Driver Disable Time from High	tDHZ				70	ns
Driver Propagation Delay(low to high)	tDPLH	RDIFF=54Ω, CLi=CL₂=100pF (Fig 3,4)		60		ns
Driver Propagation Delay (high to low)	tDPHL			60		ns
tDPLH-tDPHL	tsKEW1			5	±10	ns
Driver Differential Output Rise or Fall Time	tDR,tDF			40		ns





PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SUPPLY CURRENT						
Supply Current	I <sub>cc1</sub>	/RE=0V or VCC, DE=0V		200	500	uA
	I <sub>cc2</sub>	/RE=VCC, DE=VCC		300	600	uA
	I <sub>cc3</sub>	/RE=0, DE=VCC		0.5	10	uA
DC ELECTRICAL CHARACTERISTICS OF RECEIVER						
Receiver Input Resistance	R <sub>N</sub>	-7V≤V <sub>CM</sub> ≤12V	12			kΩ
Receiver Output Short-Circuit	I <sub>osR</sub>	0V≤V <sub>o</sub> ≤VCC	±7		±95	mA
RO Output-Low Voltage	V <sub>oL</sub>	I <sub>oUT</sub> =+4mA, V <sub>ID</sub> =-200 mV			0.4	V
Three-State Output Current at Receiver	I <sub>ozR</sub>	0.4V<V <sub>o</sub> <2.4V			±1	uA
Receiver Input Hysteresis	V <sub>hys</sub>	-7V≤V <sub>CM</sub> ≤12V		30		mV
RO Output-High Voltage	V <sub>oH</sub>	I <sub>oUT</sub> =-4mA, V <sub>ID</sub> =+200 mV	3.5			V
Positive-going input threshold voltage	V <sub>IT+</sub>	-7V≤V <sub>CM</sub> ≤12V			-10	mV
Negative-going input threshold voltage	V <sub>IT-</sub>	-7V≤V <sub>CM</sub> ≤12V	-200			mV
Input Current(A,B)	I <sub>N2</sub>	DE=0V, VCC=0 or 5V			1.0	mA
		DE=0V, VCC=0 or 5V	0.8			mA

NOTE

If no special situation occurs , VCC=5V±5% ,Temp=T<sup>MIN</sup>~T<sup>MAX</sup> , typically VCC=+5V , Temp = 25



PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DC ELECTRICAL CHARACTERISTICS OF DRIVER						
Input High Voltage	VH	DE,DI,/RE	2.0			V
Input Low Voltage	Vn	DE,DI,/RE			0.8	V
Input Current (RE,DI,/RE)	IN1	DE,DI,/RE	-2		2	uA
Thermal-Shutdown Threshold				150		°C
Thermal-Shutdown Hysteresis				20		°C
Differential Driver Output(no load)	VoD1			5		V
Differential Driver Output	VoD2	Fig 2,RL=27Ω	1.5		VCC	V
		Fig 2,RL=50	2		VCC	
Change in Magnitude of Differential Output Voltage (NOTE1)	ΔVoD	Fig 2,RL=27Ω			0.2	V
Driver Common-Mode Output Voltage	Voc	Fig 2,RL=27Ω			3	V
Change In Magnitude of Common- Mode Voltage (NOTE1)	ΔVoc	Fig 2,RL=27Ω			0.2	V
Driver Short-Circuit Output Current (short to high)	IosD <sub>1</sub>	Short to 0V~12V	35		250	mA
Driver Short-Circuit Output Current (short to low)	IosD <sub>2</sub>	Short to -7V~0V	-250		-35	mA

## TEST CIRCUIT

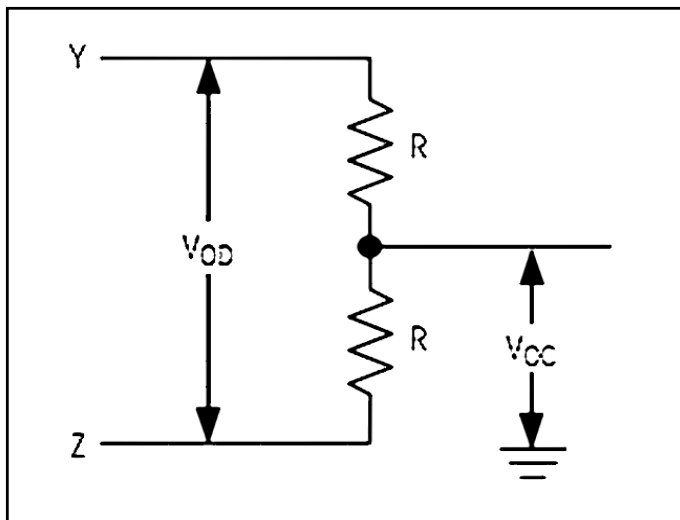


Fig 2 Driver DC Test Load

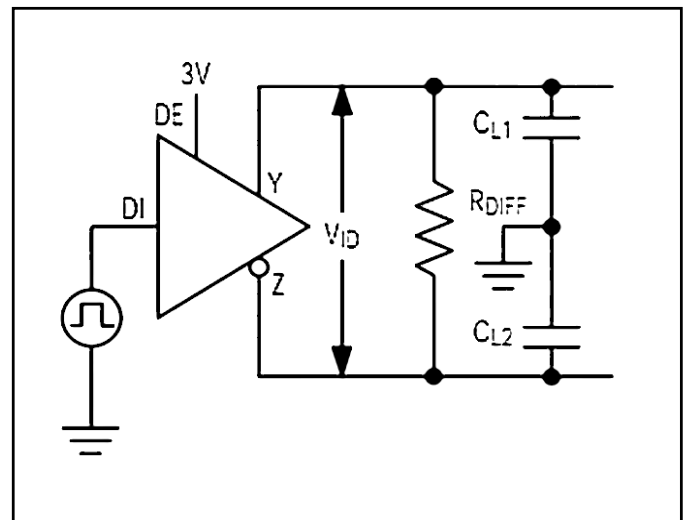


Fig 3 Driver Timing Test Circuit

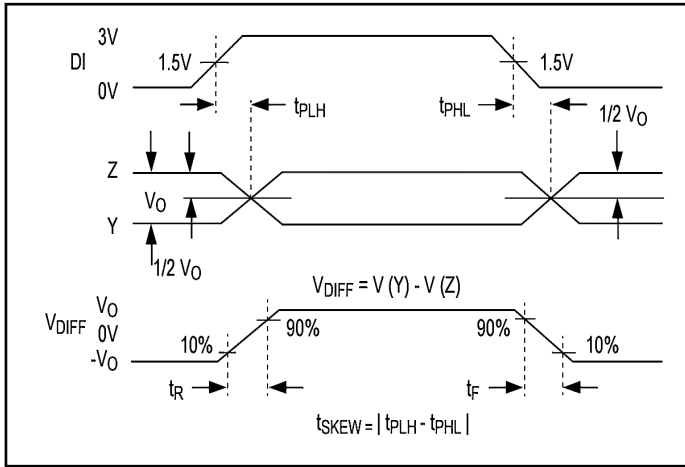


Fig 4 Driver Propagation Delays

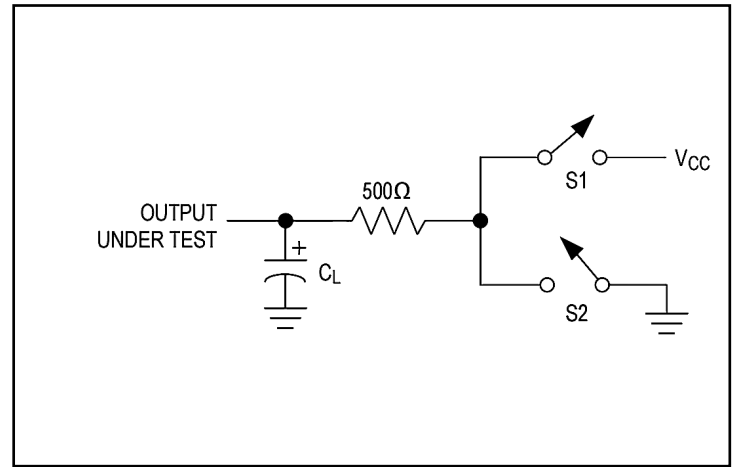


Fig 5 Driver Enable/Disable Timing Test Load

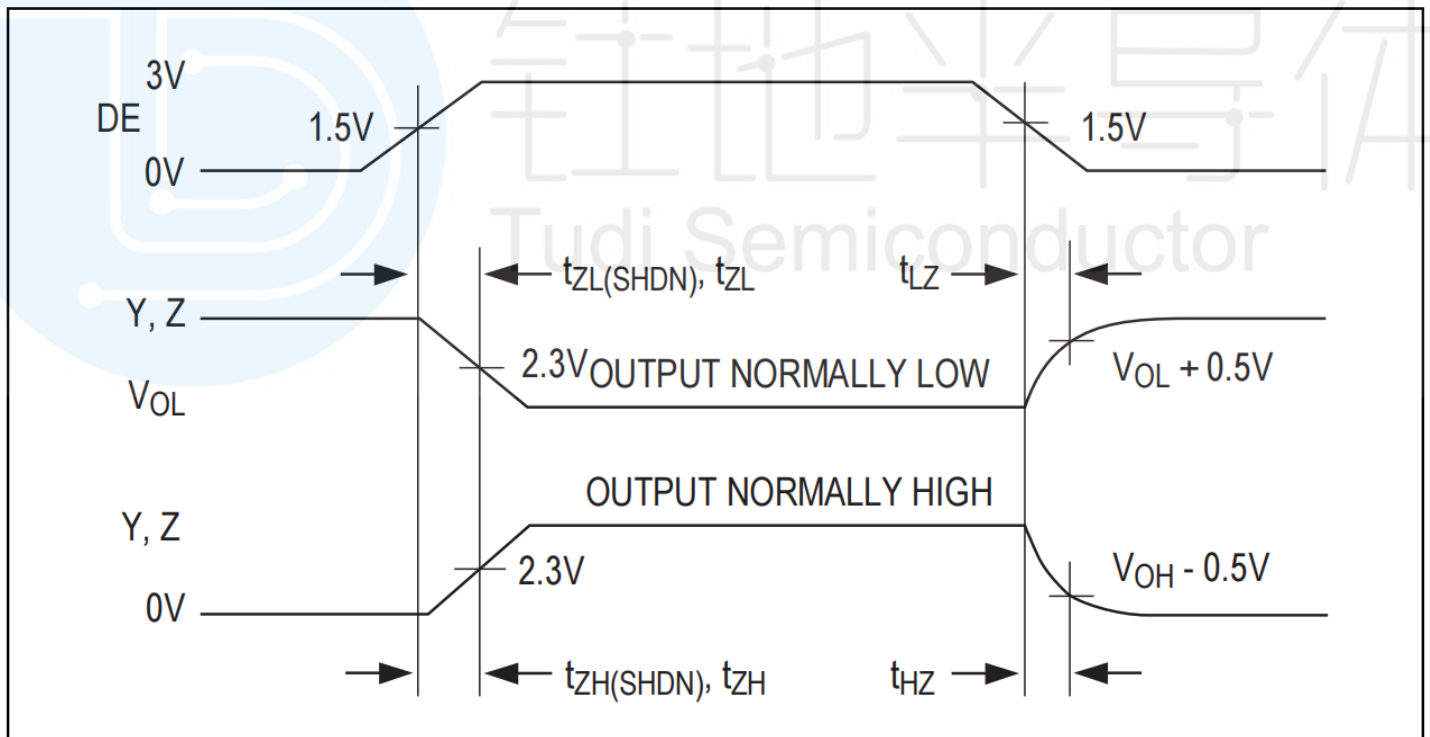


Fig 6 Driver Enable and Disable Times

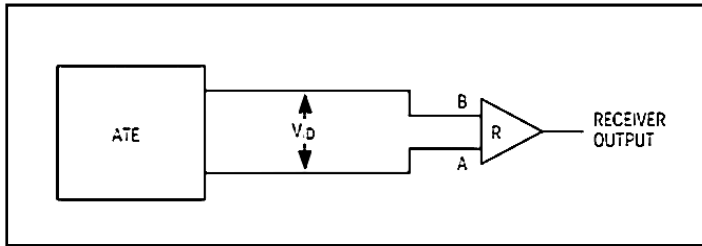


Fig 7 Receiver Propagation Delay Test Circuit

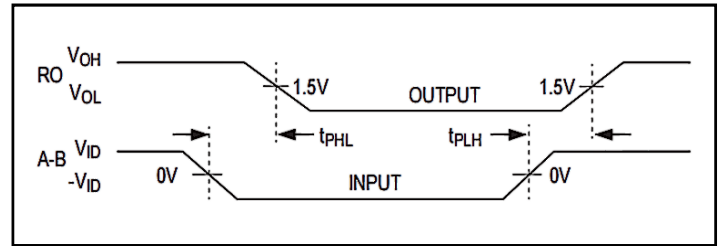


Fig 8 Receiver Propagation Delays

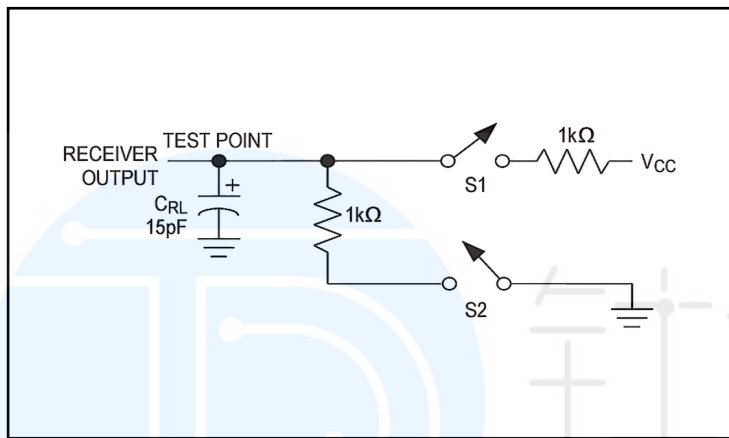


Fig 9 Receiver Enable/Disable Timing Test Load

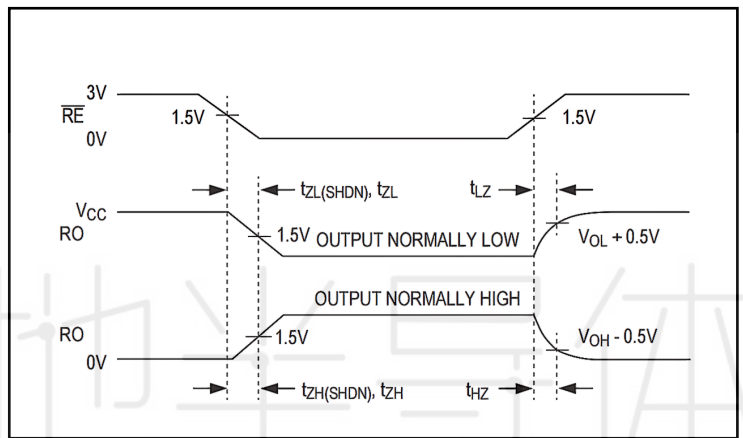


Fig 10 Receiver Enable and Disable Times

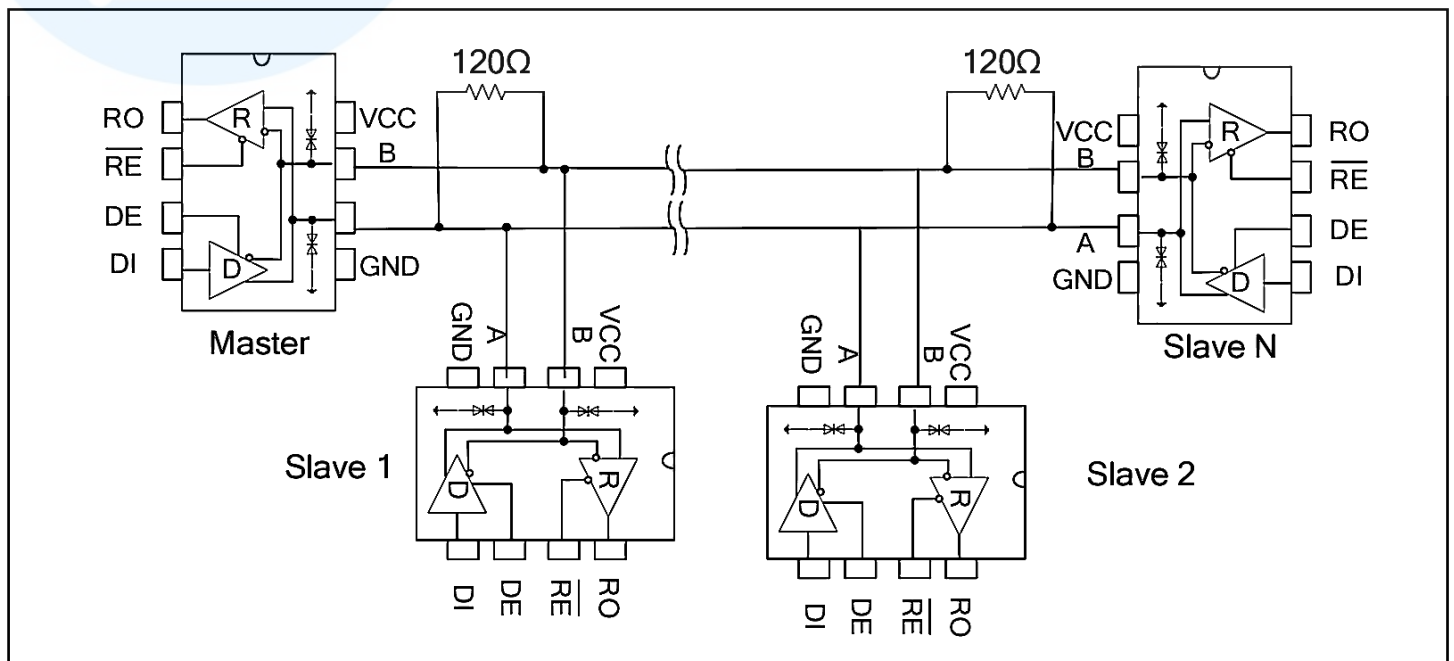


Fig11 Backbone cable type RS485 communications network



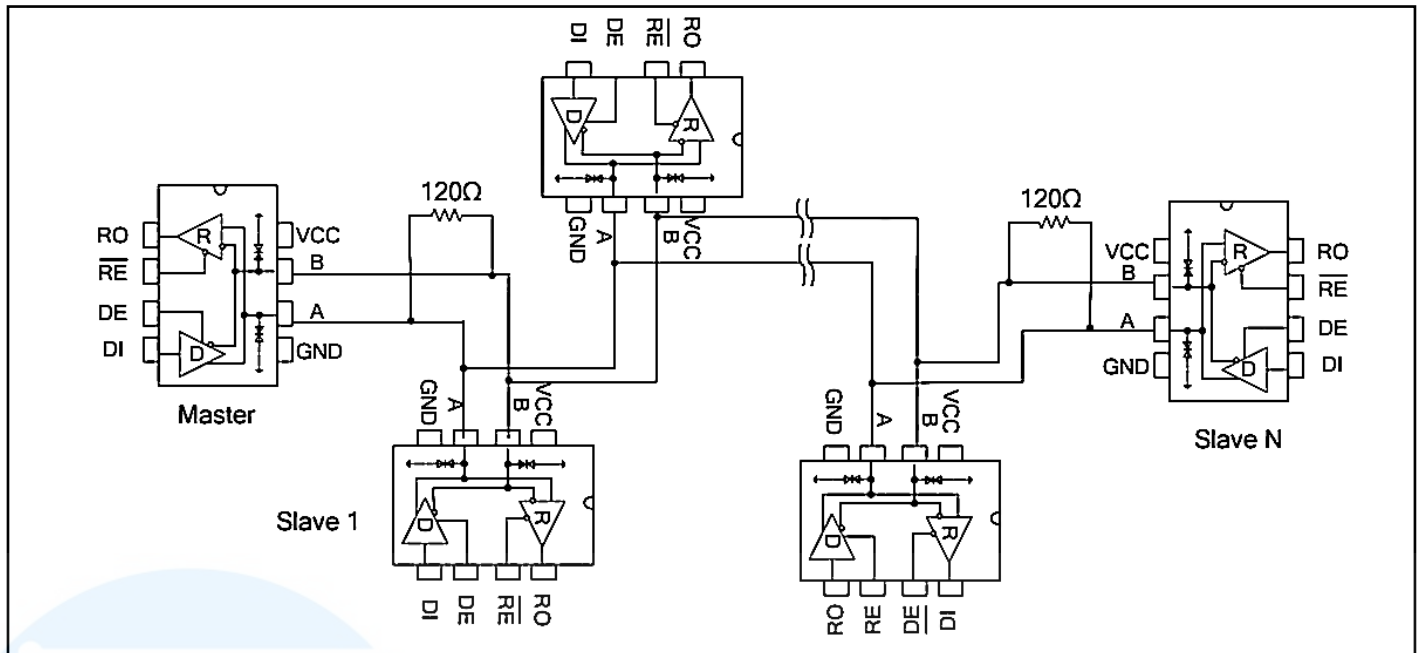


Fig12 Daisy chain topology type RS485 communications network

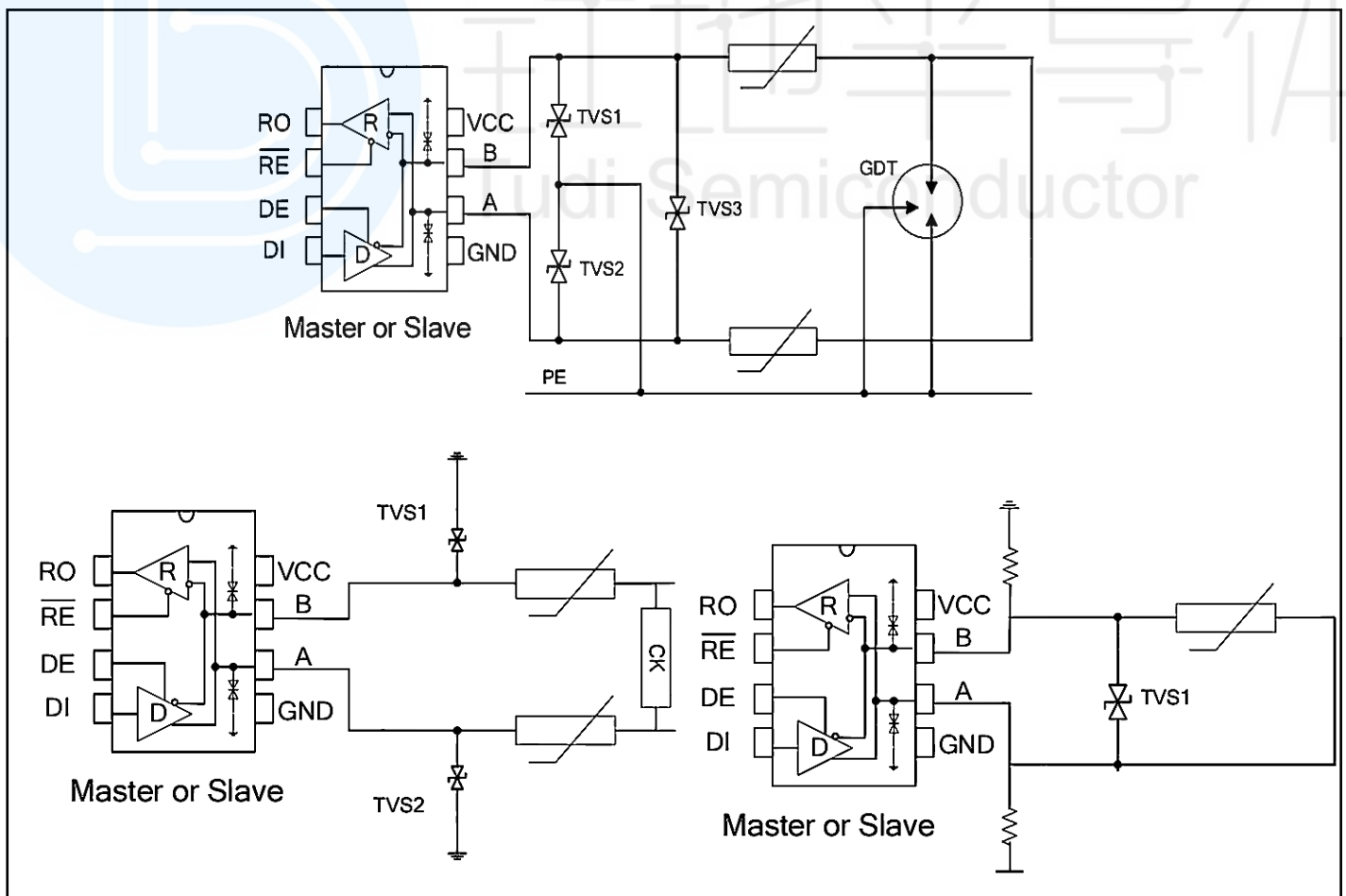


Fig13 RS485 bus ports Protection configuration



## Additional description

### Description

487E, including a driver and a receiver, is a half-duplex high-speed transceivers for RS485 / RS-422 communications. 487E features fail-safe, overvoltage protection, overcurrent protection, thermal protection, and allows / RE, DE hot-swappable. The 487allows an error-free data transmission up to 250kbps.

### Typical Application

Backbone cable type: 487Etransceiver is designed for multi-point bi-directional data communication bus transmission lines. Figure 11 shows a typical network application circuit. These devices can also be used as a cable longer than 4,000 feet of line repeater, to reduce the reflection, the transmission line should be in its ends terminated in its characteristic impedance, and stub lengths off the main line should be as short as possible. Hand in hand type: Also known as daisy chain topology, is the prior RS485 bus topology recommended by the TIA organization. The routing method is the master device and a number of slave devices connected in hand-handle configuration, as shown in Figure 12. It should be noted at that hand in handle means no branch line. This kind of topology has the advantages of small reflection and high rate of success communication. The bus port protection : In harsh environments , RS485 communication ports are usually done with static protection, lightning surge protection, and other additional protection , even prepared to prevent 380V electricity access by mistake. To avoid the destruction of intelligent instruments and industrial control host, figure 13 demonstrates three general kinds of RS485 bus port protection configuration.

### Connecting 32 Transceivers on one Bus

The standard 487E receiver input impedance is guaranteed  $>12k\Omega$  , the standard driver can drive up to 32 unit loads. These devices can be any combination, or in combination with other RS485 transceiver combination, as long as the total load does not load more than 32 units, can be connected on the same bus.

### Drive Output Protection

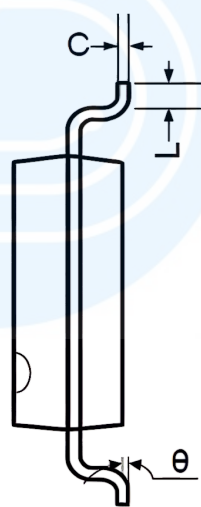
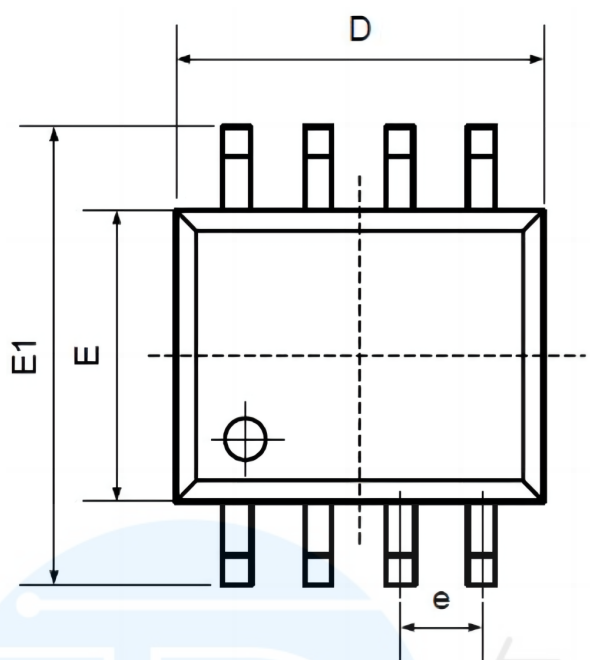
Through two mechanisms to avoid failure or a bus contention causes power consumption is too high. First, in the entire common Mode voltage range, overcurrent protection circuit provides a fast short protection. Second, when the die temperature exceeds  $150^{\circ}\text{C}$ , driver output is forced into a high impedance state by the thermal shutdown circuit.

### Fail Safe

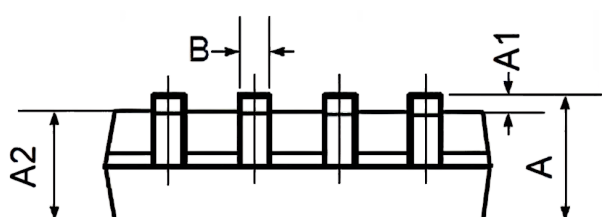
When the receiver inputs are shorted or open, or when they are connected to a terminated transmission line with all drivers disabled, 487E guarantees a logic-high receiver output. This is done by the receiver input thresholds are set between  $-10\text{mV}$  and  $-200\text{mV}$ . If the differential receiver input voltage  $(A-B) \geq -10\text{mV}$ , RO is logic high; if the voltage  $(A-B) \leq -200\text{mV}$ , RO is logic low. When attached to the terminal all transmitters on the bus are disabled, the receiver differential input voltage is pulled to  $0\text{V}$  by the termination resistor. With the receiver threshold of the 487E, this results in a logic-high with a  $10\text{mV}$  minimum noise margin. The  $-10\text{mV}$  to  $-200\text{mV}$  threshold complies with the  $\pm 200\text{mV}$  EIA/TIA-485 standard.



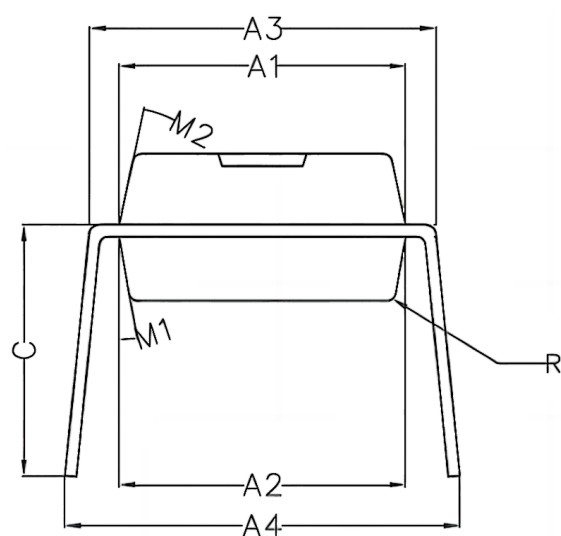
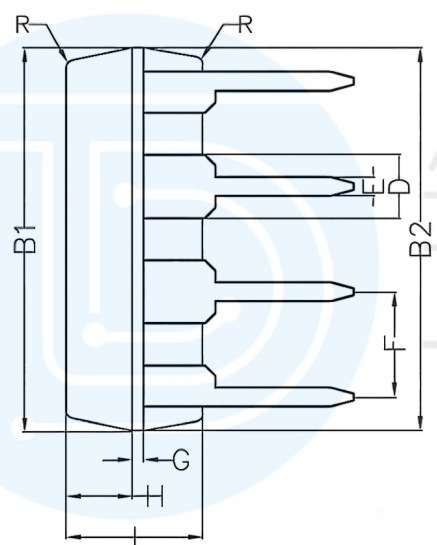
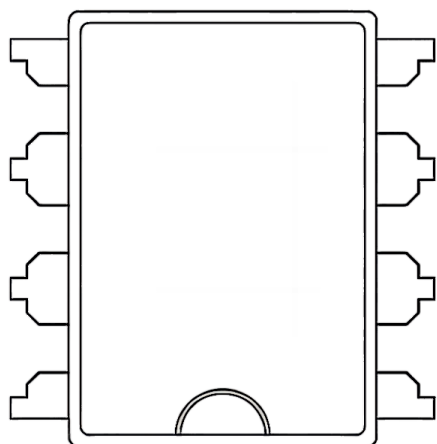
## Package SOP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°



## Package DIP8



Symbol	Min	Non	Max
A1	6.28	6.33	6.38
A2	6.33	6.38	6.43
A3	7.52	7.62	7.72
A4	7.80	8.40	9.00
B1	9.15	9.20	9.25
B2	9.20	9.25	9.30
C		5.57	
D		1.52	
E	0.43	0.45	0.47
F		2.54	
G		0.25	
H	1.54	1.59	1.64
I	3.22	3.27	3.32
R		0.20	
M1	9°	10°	11°
M2	11°	12°	13°





## Order information

Order Number	Package	Package Quantity	Marking On The park	Temperature
MAX487ECPA-TUDI	DIP8	Tube,50,A box of 2000	MAX487ECPA	0°C to 70°C
MAX487ECSA-TUDI	SOP8	Tape,Reel,2500	MAX487ECSA	
MAX487EEPA-TUDI	DIP8	Tube,50,A box of 2000	MAX487EEPA	- 40°C to 85°C
MAX487EESA-TUDI	SOP8	Tape,Reel,2500	MAX487EESA	



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