±18-K ESD Protection, RS-485 Transceiver

Features

- Exceeds Requirements of EIA-485 Standard
- Data Rate: 500 kbps
- Support Failsafe Function
- Low Power Consumption: < 1-μA Standby Supply Current
- Large Receiver Hysteresis: 60 mV
- Up to 256 Nodes on a Bus (1/8 Unit Load)
- Wide Supply Voltage: 4.5 V to 5.5 V
- SOP8 Package for Backward Compatibility
- Bus-Pin Protection:
  - ±18-kV HBM Protection
  - ±12-kV IEC61000-4-2 Contact Discharge

Applications

- E-Metering Networks
- HVAC Systems
- Video Surveillance Systems
- DMX512-Networks

Description

The TPT485E is a 4.5-V to 5.5-V powered transceiver that meets the RS-485 and RS-422 standards for balanced communication. Driver outputs and receiver inputs are protected against ±18-kV ESD strikes without latch-up.

Transmitters in this family deliver exceptional differential output voltages as 2.5 V (min) in 5-V_{CC} power supply, into the RS-485 required 54-Ω load, for better noise immunity. These devices have very low bus currents, presenting 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.

The TPT485E is available in the SOP8 package, and is characterized from –40°C to 125°C.

Typical Application Circuit

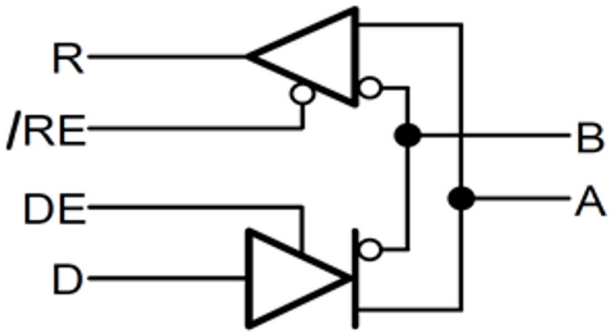


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Revision History

Date	Revision	Notes
2019-03-27	Rev.Pre.0	Preliminary version.
2019-09-10	Rev.Pre.1	Updated the ESD data.
2019-09-25	Rev.A.0	Initial version.
2020-07-24	Rev.A.1	Corrected some typos. Changed DI to D.
2024-12-24	Rev.A.2	Updated to a new datasheet format. Added the MSL value in the Order Information. Added Tape and Reel Information. Updated the POD.

Pin Configuration and Functions

TPT485E
SOP8
Top View

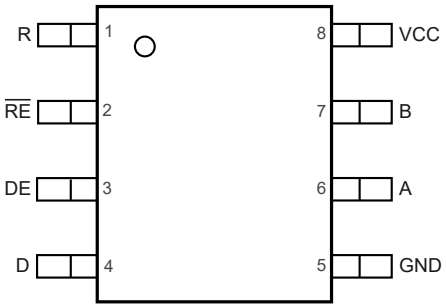


Table 1. Pin Functions: TPT485E

Pin No.	Name	I/O	Description
1	R	Digital Output	Receiver output.
2	$\overline{RE}$	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	Non-inverting receiver input A and non-inverting driver output A.
7	B	Bus Input/ Output	Inverting receiver input B and inverted driver output B.
8	VCC	Power	Power Supply.

Functional Table

Table 2. Driver Pin Functions

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

Table 3. Receiver Pin Functions

Differential Input	Enable	Output	Description
$V_{ID} = V_A – V_B$	$\overline{RE}$	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
Open, Short, Idle Bus	L	H	Out of polarity correction time

Specifications

Absolute Maximum Ratings (1)

Parameter	Min	Max	Unit
V_{CC} to GND		7	V
Input Voltages D, DE, $\overline{RE}$	−0.3	V_{CC} + 0.3	V
I/O Voltages A, B	−15	15	V
A, B (Transient Pulse through 100 Ω)	−100	100	V
R	−0.3	V_{CC} + 0.3	V
Short-Circuit Duration A, B		Continuous	
ESD Rating		See Specification Table	

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Recommended Operating Conditions

Parameter		Min	Typ	Max	Unit
	Supply Voltage			5.5	V
T_A	Operating Temperature Range	−40		125	°C
	Bus Pin Common-Mode Voltage Range	−7		12	V
T_J	Maximum Junction Temperature (Plastic Package)			150	°C
T_{STG}	Maximum Storage Temperature Range	−65		150	°C

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition		Minimum Level	Unit
	Contact Discharge	per IEC 61000-4-2	Bus Pins	12	kV
HBM	Human Body Model ESD	per ANSI/ESDA/JEDEC JS-001/ANSI/ESD STM5.5.1	Bus Pin s	18	kV
			All Pins except Bus Pins	4	kV
CDM	Charged Device Model ESD	per ANSI/ESDA/JEDEC JS-002 (1)		1,500	V

(1) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOP8	136		°C/W

Electrical Characteristics

All test conditions: V_{CC} = 5 V, over operating free-air temperature range, unless otherwise noted.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Driver							
$\|V_{OD}\|$	Driver Differential-Output Voltage Magnitude	R_L = 60 Ω, −7 V ≤ V_{test} ≤ 12 V	See Figure 1B	2.0	3.5		V
		R_L = 54 Ω (RS-485)	See Figure 1A	2.0	3.4		
		R_L = 100 Ω (RS-485)		2.7	3.7		
$\Delta\|V_{OD}\|$	Change in Magnitude of Driver Differential-Output Voltage	R_L = 54 Ω, C_L = 50 pF	See Figure 1A	−50		50	mV
$V_{OC(SS)}$	Steady-Stage Common-Mode Output Voltage	Center of two 27-Ω load resistors	See Figure 1A	1	V_{CC} / 2	3	V
ΔV_{OC}	Change in Differential Driver Common-Mode Output Voltage			−65		65	mV
$V_{OC(PP)}$	Peak-to-Peak Driver Common-Mode Output Voltage				600		
$\|I_{OS}\|$	Driver Short-Circuit Output Current	$\|I_{OS}\|$ with A shorted to B			90	110	mA
Receiver							
V_{IT+}	Positive-Going Receiver Differential-Input Voltage Threshold				−100	−15	mV
V_{IT-}	Negative-Going Receiver Differential-Input Voltage Threshold			−240	−150		mV
V_{HYS} (1)	Receiver Differential-Input Voltage Threshold Hysteresis (V_{IT+} – V_{IT-})				60		mV
V_{IH}	Logic Input High Voltage	D, DE, $\overline{RE}$		2			V
V_{IL}	Logic Input Low Voltage	D, DE, $\overline{RE}$				0.8	V
V_{OH}	Receiver High-Level Output Voltage	I_{OH} = −8 mA		4.0	V_{CC} − 0.3		V
V_{OL}	Receiver Low-Level Output Voltage	I_{OL} = 8 mA			0.2	0.4	V
I_i	DE = 0, V_{CC} = 0 or V_{CC} = 5.5 V	V_I = 12 V			30	120	μA
		V_I = −7 V		−100	−50		μA
RA, RB	Bus Input Impedance	V_A = −7 V, V_B = 12 V; or V_A = 12 V, V_B = −7 V		96			kΩ

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{OZ}	Receiver High-Impedance Output Current	V_O = 0 V or V_{CC}, $\overline{RE}$ at V_{CC}		−1		1	μA
I_{OSR}	Receiver Output Short to Ground Current	REN = 0, DE = V_{CC}			80	95	mA
Logic							
I_{in}	Input Current ($\overline{RE}$, DE, D)	4.5 V < V_{CC} < 5.5 V		−5		5	μA
Supply							
I_{CC}	Supply Current (Quiescent)	Driver and receiver enabled	DE = V_{CC}, $\overline{RE}$ = GND, no load		650	800	μA
		Driver enabled, receiver disabled	DE = $\overline{RE}$ = V_{CC}, no load		450	600	
		Driver disabled, receiver enabled	DE = $\overline{RE}$ = GND, no load		450	600	
		Driver and receiver disabled	DE = GND, $\overline{RE}$ = D = V_{CC}, no load		0.5	2	

Switching Characteristics

Parameter		Conditions		Min	Typ	Max	Unit
Driver							
t_r, t_f	Driver Differential-Output Rise and Fall Times	R_L = 54 Ω, C_L = 50 pF	See Figure 2		300		ns
t_{PHL}, t_{PLH}	Driver Propagation Delay			200	300	410	
$t_{SK(P)}$	Driver Pulse Skew, $\|t_{PHL} - t_{PLH}\|$				50	90	
t_{PHZ}, t_{PLZ}	Driver Disable Time	RE = 0	See Figure 3		50	100	ns
		RE = V_{CC}			50	100	
t_{PZH}, t_{PZL}	Driver Enable Time	RE = 0			200	450	ns
		RE = V_{CC}			2,800	4,000	
Receiver							
t_r, t_f	Receiver Output Rise and Fall Times	C_L = 15 pF	See Figure 5		30		ns
t_{PHL}, t_{PLH}	Receiver Propagation Delay Time				100	150	
$t_{SK(P)}$	Receiver Pulse Skew, $\|t_{PHL} - t_{PLH}\|$					25	
t_{PHZ}, t_{PLZ}	Receiver Disable Time		See Figure 6		20	65	ns
t_{PZL}, t_{PZH}	Receiver Enable Time	DE = V_{CC}	See Figure 6		130	250	ns
		DE = 0			2,800	4,000	

Test Circuits and Waveforms

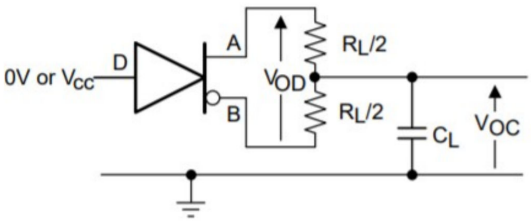


Figure 1A

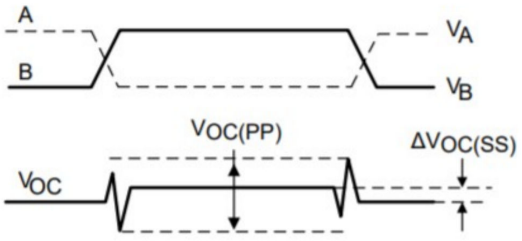


Figure 1B

Figure 1. DC Driver Test Circuits

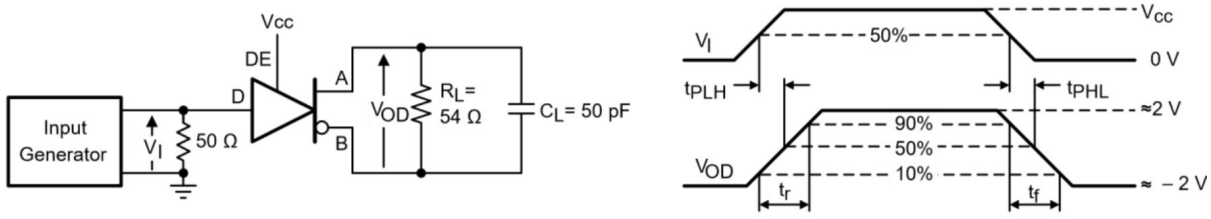


Figure 2. Driver Propagation Delay and Differential Transition Times

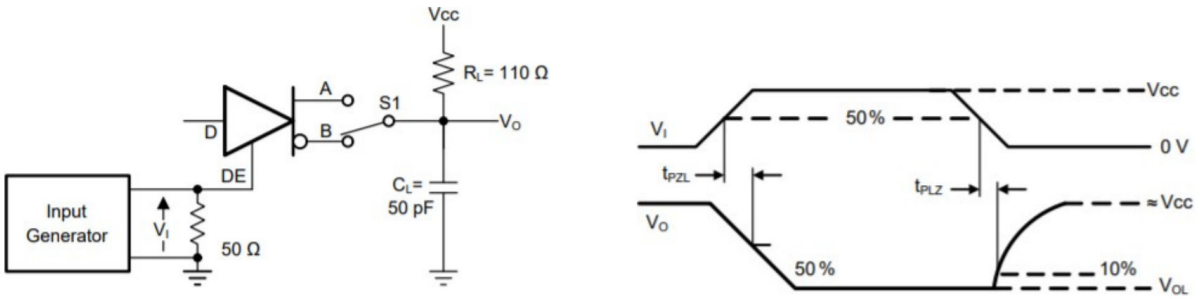


Figure 3. Driver Enable and Disable Times



Figure 4. Driver Propagation Delay and Rise/Fall Time Measurement

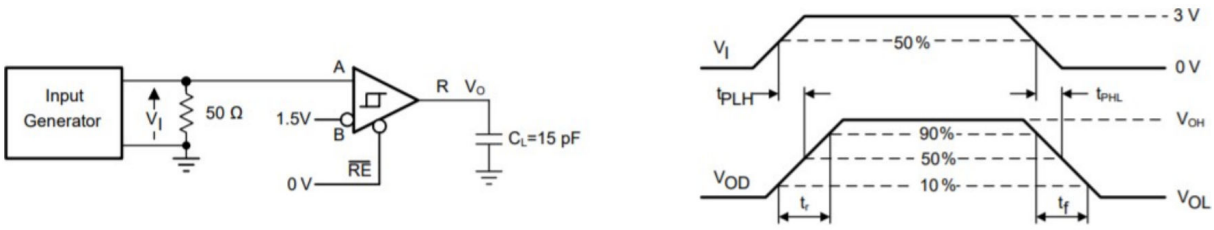


Figure 5. Receiver Propagation Delay and Data Rate

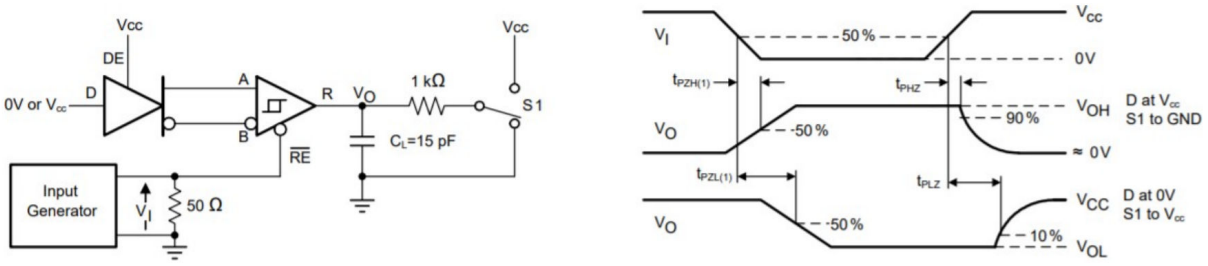


Figure 6. Receiver Enable and Disable Times

Application and Implementation

Note

Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Typical Application

Figure 7 shows the typical application schematic.

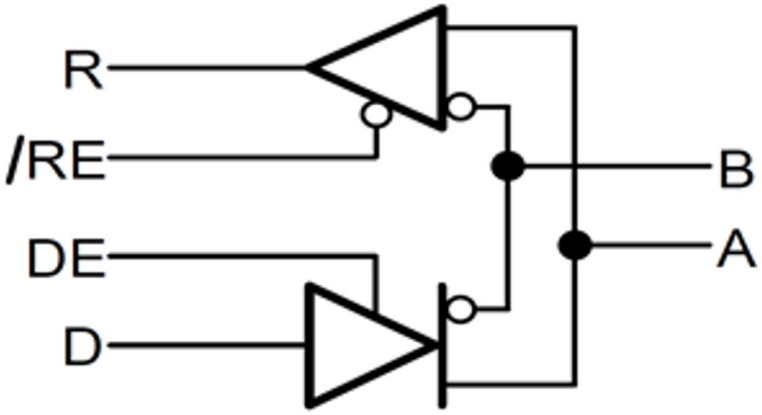
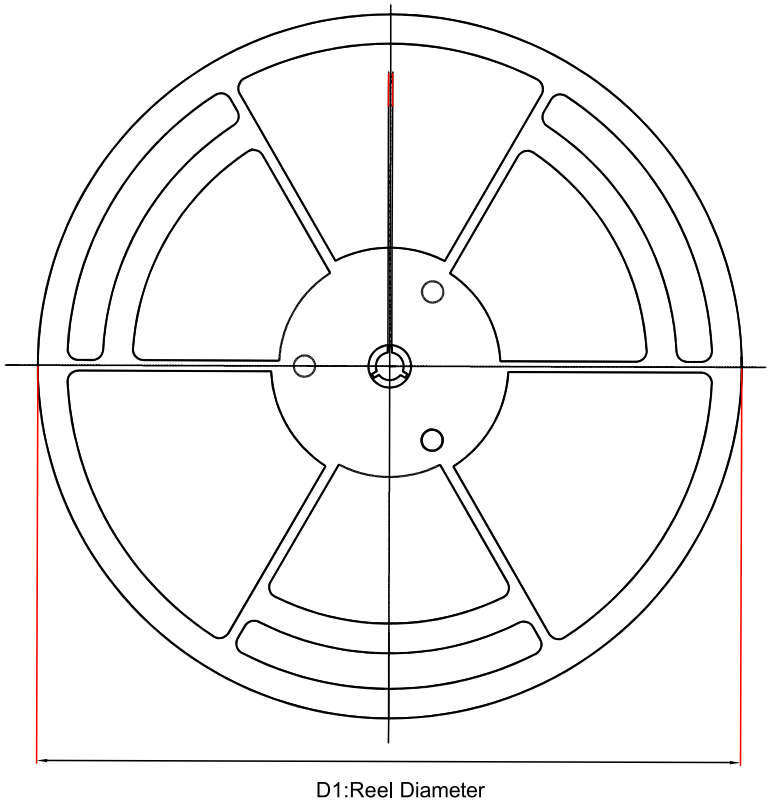
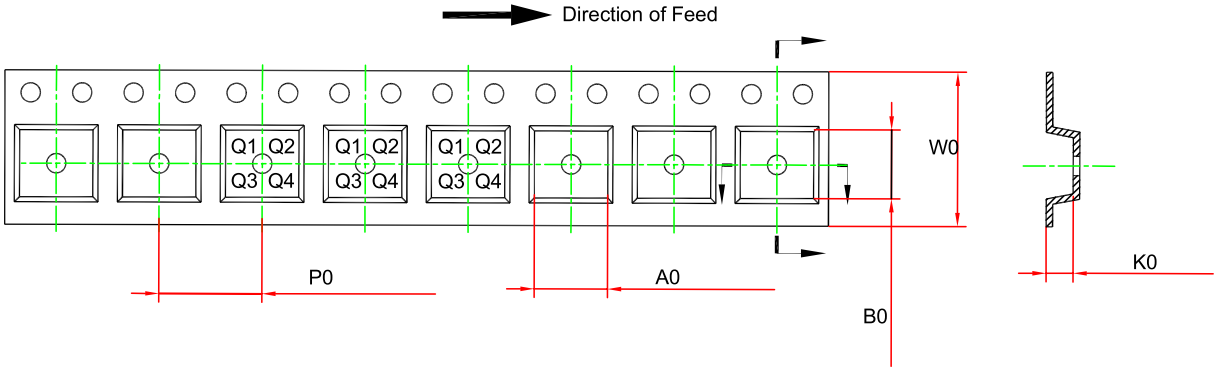


Figure 7. Typical Application Circuit

Tape and Reel Information





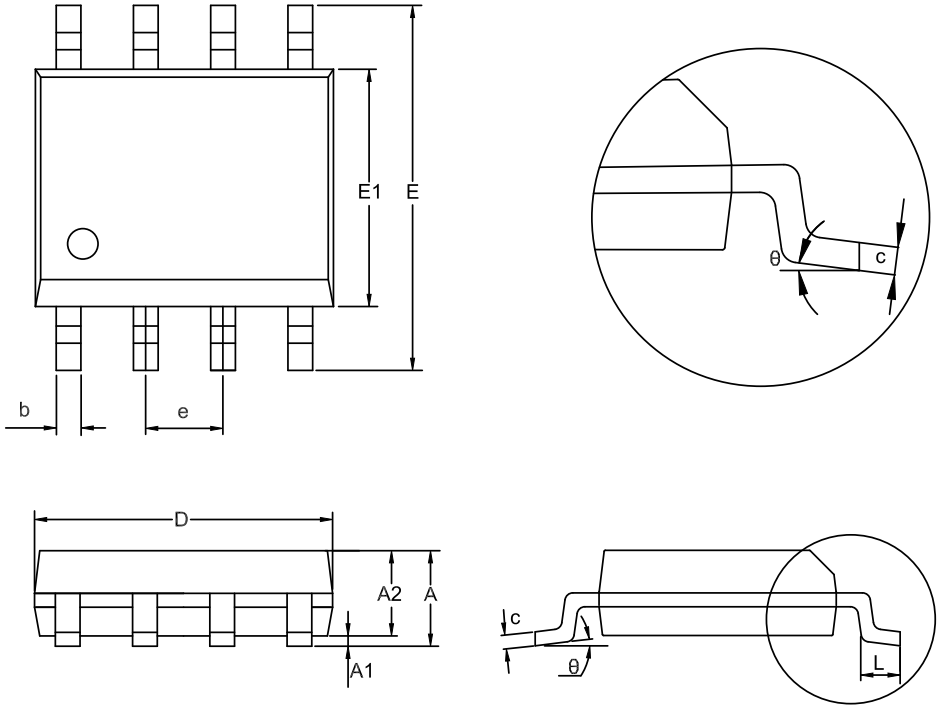
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) (1)	B0 (mm) (1)	K0 (mm) (1)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPT485E-SO1R	SOP8	330	17.6	6.5	5.4	2	8	12	Q1

(1) The value is for reference only. Contact the 3PEAK factory for more information.

Package Outline Dimensions

SOP8

Package Outline Dimensions SO1(SOP-8-A)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.000	0.016	0.039
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPT485E-SO1R	−40 to 125°C	SOP8	T485E	3	Tape and Reel, 4000	Green

Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

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