

3.3V低功耗、10Mbps半双工RS-485收发器

SP3485EN-Y SOP8

1 描述

SP3485EN-Y是一款3.3V低功耗半双工RS-485收发器，采用3.0V至3.6V单电源供电。总线接口引脚在所有工作模式下均受到过压保护，确保在严苛工业环境中实现稳健的通信。

SP3485EN-Y支持10Mbps传输速率。在更长的电缆敷设长度和/或存在大接地环路电压的情况下，-7V至+12V输入共模范围可实现可靠的数据通信。20mV典型接收器迟滞可提供高噪声抑制。此外，当总线开路或短路时，接收器失效防护功能可确保输出逻辑高电平。

SP3485EN-Y采用SOP8封装，专为空间受限型应用设计。

2 特性

- 符合或超过TIA/EIA-485A标准的要求
- 3V至3.6V电源电压
- 总线I/O保护
- 闩锁性能超过800mA，符合JESD 78 规范
- 适用于热插拔功能的无干扰上电/断电
- 欠压锁定
- 工作环境温度范围：-40°C to 85°C
- 增强型接收器迟滞，可获得抗噪能力
- 接收器开路失效保护
- 低功耗关断模式
- 总线最多支持32个收发器节点
- 最高传输速率：10Mbps

3 Applications

- Automotive data links
- Industrial-Control Local Area Networks
- Integrated Services Digital Networks
- Building automation
- Electricity meters
- Transceivers for EMI-Sensitive applications

4 Selection Guide

Part Number	Data Rate (Mbps)	V _{CC} Range (V)
SP3485EN-Y	10	3.0 to 3.6

5 Ordering Information

SP3485EN-Y	SP3485EN-Y	SOP8	3000pcs/13Inch Tape & Reel
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6 Pin Configuration and Function

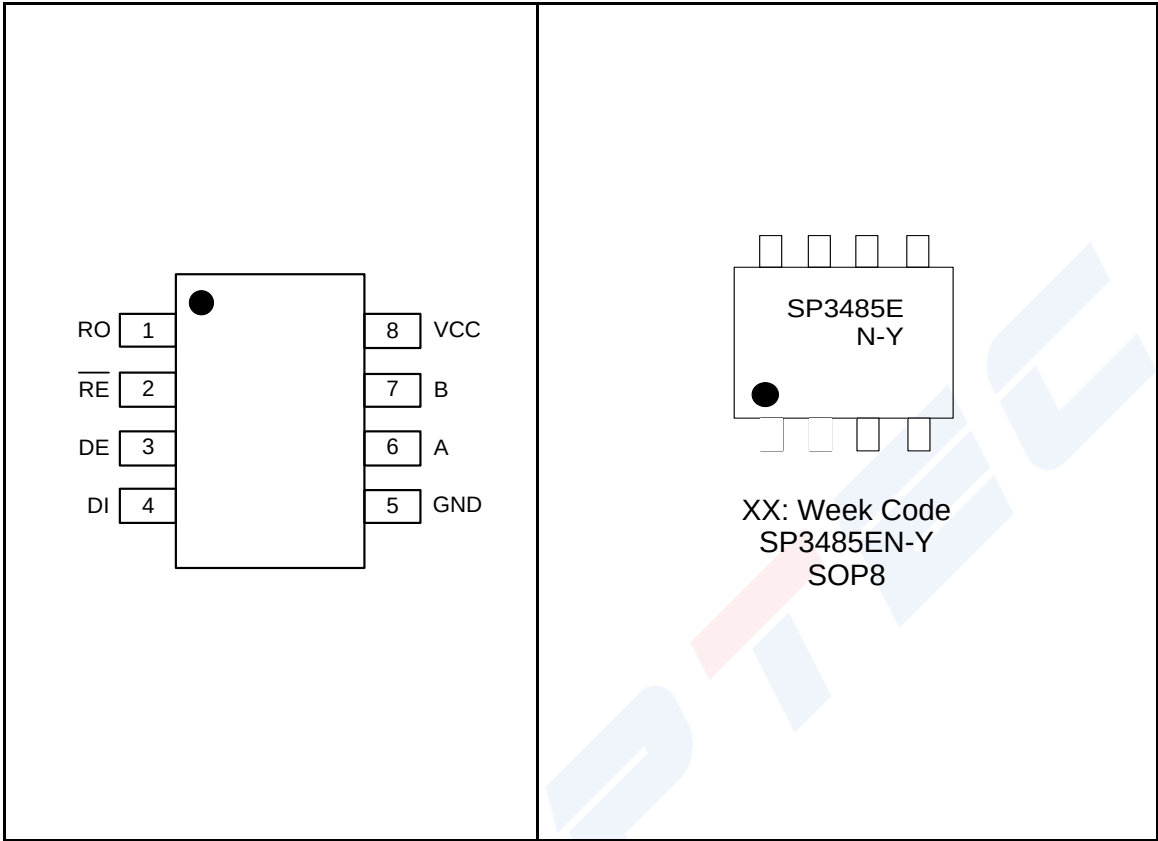


Table 6. Pin Functions of SP3485EN-Y

Pin No.	Pin Name	Function
1	RO	Receive data output
2	$\overline{\text{RE}}$	Receiver enable, active low
3	DE	Driver enable, active high
4	DI	Driver data input
5	GND	Local device ground
6	A	Driver output or receiver input (complementary to B)
7	B	Driver output or receiver input (complementary to A)
8	VCC	Supply voltage

7 Specifications

7.1 Recommended Operating Conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{CC}	Supply Voltage		3.0	3.3	3.6	V

V _I	Input voltage at any bus terminal (separately or common mode)	Note1	-7		+12	V
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I _O	Output current, driver		-60		60	mA
I _{OR}	Output current, receiver	SP3485EN-Y	-8		8	mA
R _L	Differential load resistance		54	60		Ω
1/ t _{UI}	Signaling rate					
		SP3485EN-Y			10	Mbps
T _A	Operating free-air temperature (see application section for thermal information)		-40		85	℃
T _J	Junction temperature		-40		125	℃

Note 1: The algebraic convention, in which the least positive (most negative) limit is designated as minimum is used in this data sheet.

7.2 Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{CC}	Supply voltage		-0.5		6.0	V
V _I	Voltage on A, B		-15		+15	V
	Voltage on any logic pin (D, DE , $\overline{RE}$)		-0.3		6.0	V
I _O	RXD output current		-60		+60	mA
T _{STG}	Storage temperature		-65		150	°C
T _L	Lead Temperature for Soldering 10 Seconds				260	°C

Note 1: Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute maximum ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If briefly operating outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not sustain damage, but it may not be fully functional. Operating the device in this manner may affect device reliability, functionality, performance, and shorten the device lifetime.

7.3 Electrical Characteristics (Static) (Note 1)

over operating free-air temperature range (unless otherwise noted). All typical values are at 25°C and supply voltage of VCC = 3.3 V ±5%.

7.3 Electrical Characteristics (Static) (Note 1) (continued)

over operating free-air temperature range (unless otherwise noted). All typical values are at 25°C and supply voltage of $V_{CC}=3.3V\pm5\%$.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply						
I_{CC}	Supply current, $V_{CC} = 3\text{ V to }3.6\text{ V}$	$\overline{RE} = 0\text{ V}$, $DE = V_{CC}$, No load (Driver and receiver enabled)		1.45	3	mA
		$\overline{RE} = V_{CC}$, $DE = V_{CC}$, No load (Driver enabled, receiver disabled)		1.45	3	mA
		$\overline{RE} = 0\text{ V}$, $DE = 0\text{ V}$, No load (Driver disabled, receiver enabled)		0.7	2.4	mA
		$\overline{RE} = V_{CC}$, $DE = 0\text{ V}$, D = open, No load (Driver and receiver disabled)		0.3	3	μA

7.3 Electrical Characteristics (Static) (Note 1) (continued)

over operating free-air temperature range (unless otherwise noted). All typical values are at 25°C and supply voltage of $V_{CC} = 3.3V \pm 5\%$

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Driver						
V _{OD}	Driver differential output voltage magnitude	R _L = 60 Ω, -15 V ≤ V _{TEST} ≤ 15 V, See Figure 8-1	1.5	3.4		V
		R _L = 100 Ω, See Figure 8-2	2	4		V
		R _L = 54 Ω, See Figure 8-2	1.5	3.4		V
Δ V _{OD}	Change in magnitude of driver differential output voltage	R _L = 54 Ω or 100 Ω See Figure 8-2	-50		50	mV
V _{OC}	Common-mode output voltage	R _L = 54 Ω or 100 Ω See Figure 8-2	1	V _{CC} /2	3	V
V _{OC(SS)}	Steady-state common-mode output voltage	R _L = 54 Ω or 100 Ω See Figure 8-2	-50		50	mV
I _{OS}	Short-circuit output current	DE = V _{CC} , -15V ≤ (V _A or V _B) ≤ 15V	-250		250	mA
Receiver						
I _I	Bus input current	DE = 0V, V _{CC} = 0V or 5.5V, V _I = 12V		70	125	μA
		DE = 0V, V _{CC} = 0V or 5.5V, V _I = -7V	-100	-60		
V _{TH+}	Positive-going input threshold voltage	Over common-mode range of ± 15 V	40	125	200	mV
V _{TH-}	Negative-going input threshold voltage		-200	-125	-40	
V _{HYS}	Input hysteresis			250		
V _{TH(FSH)}	Input fail-safe threshold		-40		40	
C _{A,B}	Input differential capacitance	Measured between A and B, f = 1 MHz		50		pF

7.3 Electrical Characteristics (Static) (Note 1) (continued)

over operating free-air temperature range (unless otherwise noted). All typical values are at 25°C and supply voltage of VCC=3.3V±5%.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{OH}	Output high voltage	I _{OH} = -8 mA	VCC-0.4	VCC-0.1		V
V _{OL}	Output low voltage	I _{OL} = 8 mA		0.1	0.4	V
I _{OZ}	Output high-impedance current	V _O = 0 V or VCC, R _E = VCC	-1		1	μA
Logic						
V _{IH}	Input High Voltage	DE, D, $\overline{RE}$	0.7V _{CC}			V
V _{IL}	Input low Voltage	DE, D, $\overline{RE}$			0.3V _{CC}	V
I _I	Input current on DE pin	1.65 V ≤ V _{CC} ≤ 5.5 V, 0 V ≤ V _{IN} ≤ V _{CC}			5	μA
	Input current on D, $\overline{RE}$ pin	1.65 V ≤ V _{CC} ≤ 5.5 V, 0 V ≤ V _{IN} ≤ V _{CC}	-5			μA
Thermal Protection						
T _{SD}	Thermal shutdown threshold	Temperature rising	150	170		℃
T _{HYS}	Thermal shutdown hysteresis			10		℃

7.4 Electrical Characteristics (Dynamic)—10Mbps (Note 1)

over recommended operating conditions. All typical values are at 25°C and supply voltage of $V_{CC}=5V$.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
Driver							
t_R, t_F	Driver differential output rise/fall time	$R_L = 54\ \Omega$, $C_L = 50\ \text{pF}$, see Figure 8-3	$V_{CC} = 3\ \text{to}\ 3.6\ \text{V}$, Typical at 3.3 V	4	12	20	ns
			$V_{CC} = 4.5\ \text{to}\ 5.5\ \text{V}$, Typical at 5 V	4	13	20	ns
t_{PHL}, t_{PLH}	Driver propagation delay time		$V_{CC} = 3\ \text{to}\ 3.6\ \text{V}$, Typical at 3.3 V	6	18	30	ns
			$V_{CC} = 4.5\ \text{to}\ 5.5\ \text{V}$, Typical at 5 V	4	15	25	ns
$t_{SK(P)}$	Driver differential output pulse skew, $ t_{PHL} - t_{PLH} $		$V_{CC} = 3\ \text{to}\ 3.6\ \text{V}$, Typical at 3.3 V		1	3	ns
			$V_{CC} = 4.5\ \text{to}\ 5.5\ \text{V}$, Typical at 5 V		0.5	3	ns
t_{PHZ}, t_{PLZ}	Disable time	See Figure 8-4 and Figure 8-5		25	70	ns	
t_{PZH}, t_{PZL}	Enable time	$\overline{RE} = 0\ \text{V}$, See Figure 8-4 and Figure 8-5		23	70	ns	
t_{PSH}, t_{PSL}		$\overline{RE} = V_{CC}$, See Figure 8-4 and Figure 8-5		2.4	4.5	μs	
t_{PHS}, t_{PLS}	Time to shutdown	$\overline{RE} = V_{CC}$, See Figure 8-4 and Figure 8-5	50		500	ns	
Receiver							
t_R, t_F	Receiver output rise/fall time	$C_L = 15\ \text{pF}$, see Figure 8-6		4	8	ns	
t_{PHL}, t_{PLH}	Receiver propagation delay time		10	18	58	ns	
$t_{SK(P)}$	Receiver output pulse skew, $ t_{PHL} - t_{PLH} $			0.5	5	ns	

7.4 Electrical Characteristics (Dynamic)—10Mbps (continued) (Note 1)
over recommended operating conditions. All typical values are at 25°C and supply voltage of $V_{CC}=5V$.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Receiver						
t_{PHZ}, t_{PLZ}	Receiver disable time			15	35	ns
t_{PZL}, t_{PZH}	Receiver enable time	DE = VCC, see Figure 8-7		15	82	ns
t_{PSH}, t_{PSL}		DE = 0 V, see Figure 8-8		2.5	5	μs
$t_{D(OFS)}$	Delay to enter fail-safe operation	$C_L = 15\text{ pF}$, see Figure 8-9	7	11	18	μs
$t_{D(FSO)}$	Delay to exit fail-safe operation		13	23	60	ns
t_{PHS}, t_{PLS}	Time to shutdown	DE = 0 V, see Figure 8-8	50		500	ns

8 Parameter Measurement Information

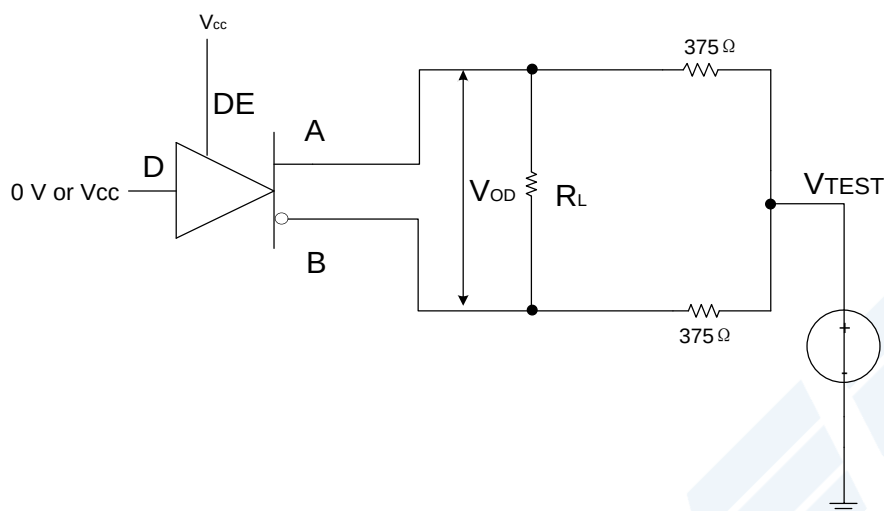


Figure 8-1. Measurement of Driver Differential Output Voltage With Common-Mode Load

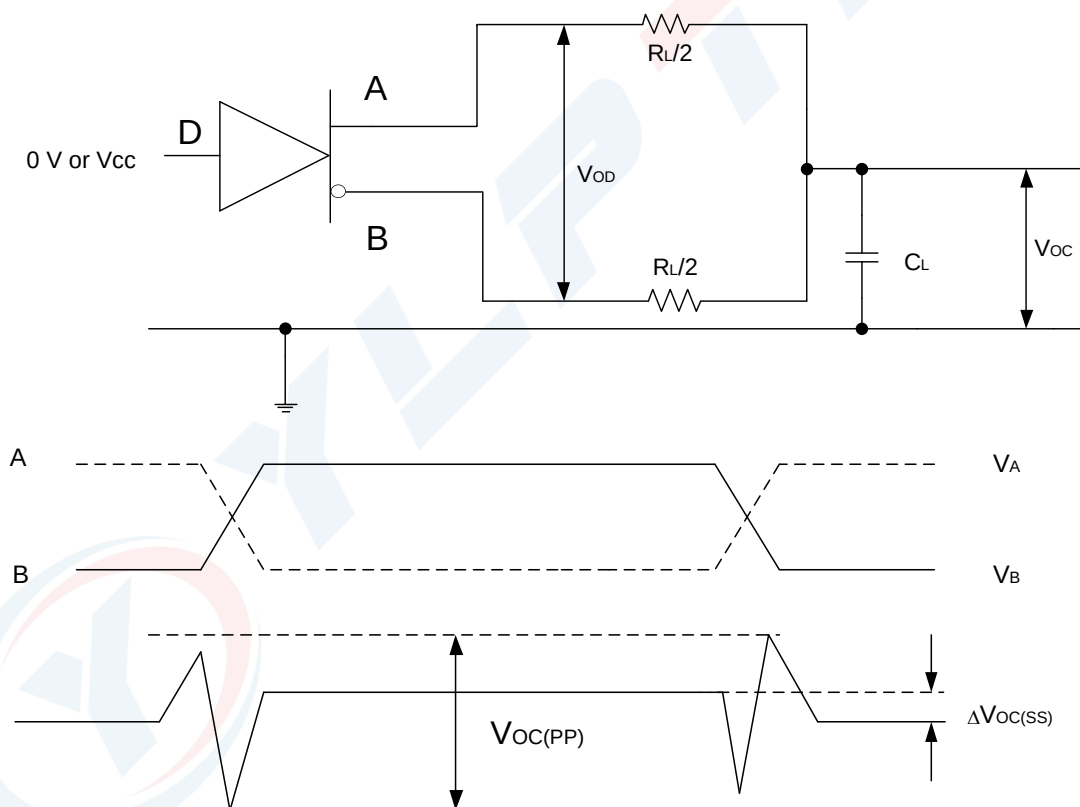


Figure 8-2. Measurement of Driver Differential and Common-Mode Output With RS-485 Load

8 Parameter Measurement Information (continued)

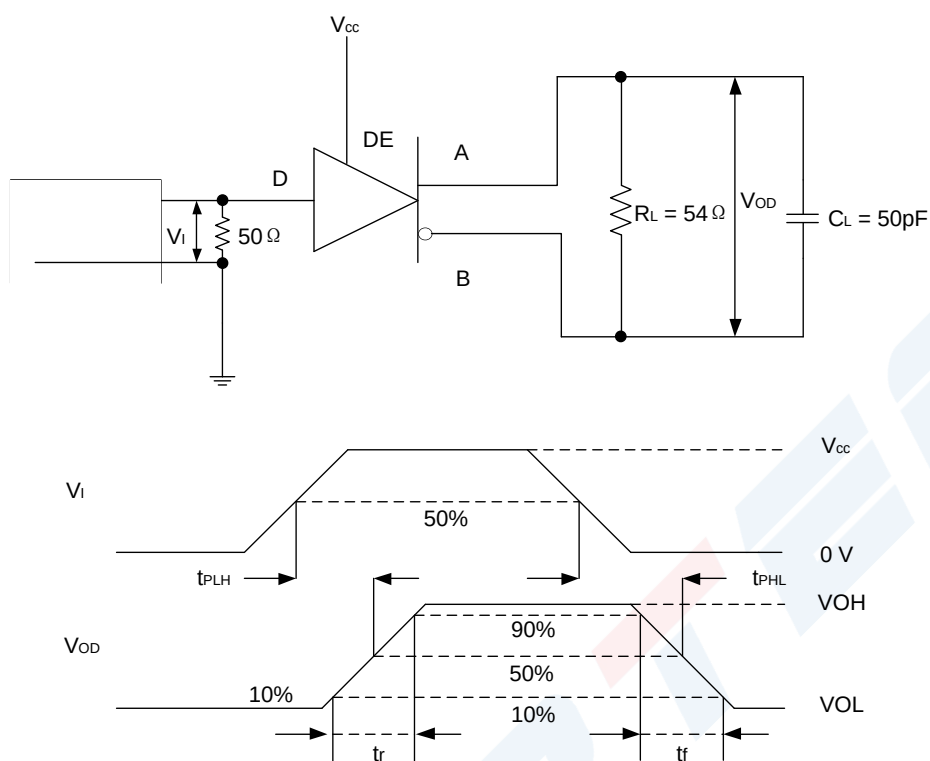


Figure 8-3. Measurement of Driver Differential Output Rise and Fall Times and Propagation Delays

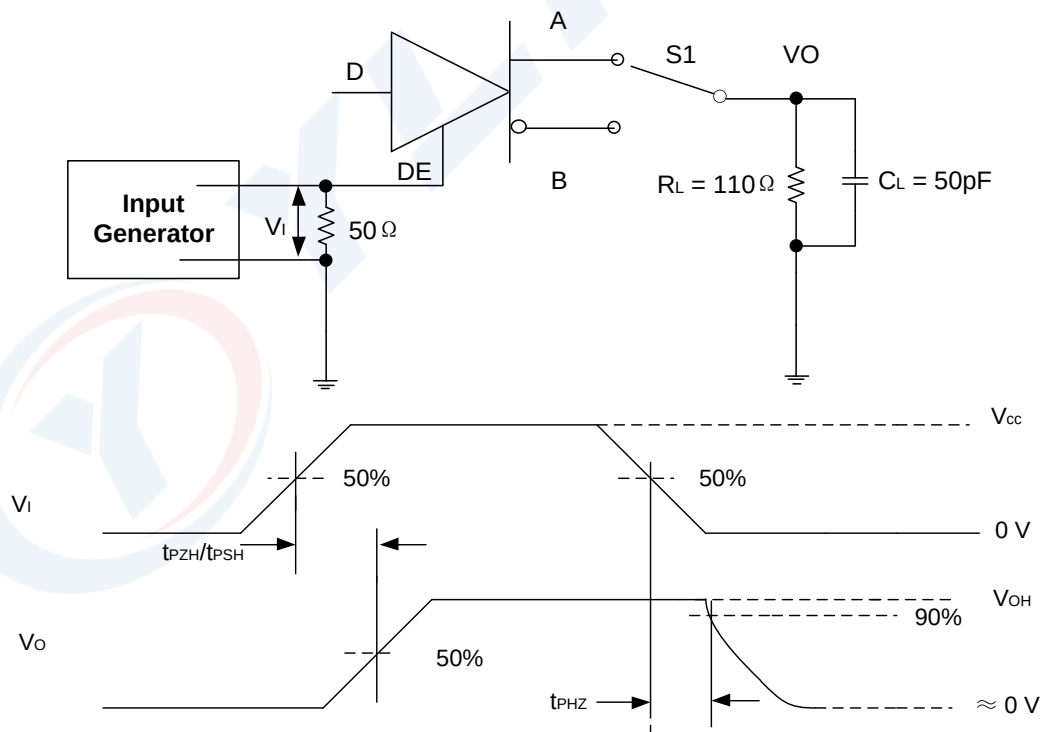


Figure 8-4. Measurement of Driver Enable and Disable Times With Active High Output and Pull-Down Load

8 Parameter Measurement Information (continued)

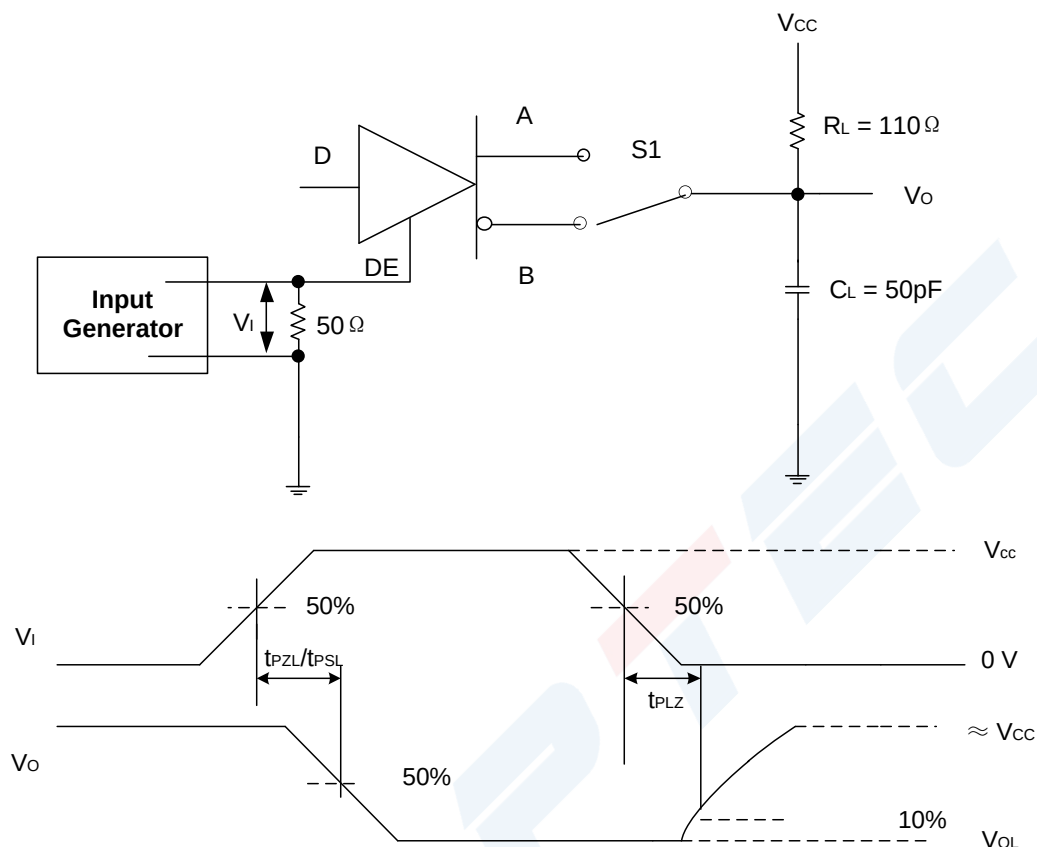


Figure 8-5. Measurement of Driver Enable and Disable Times With Active Low Output and Pull-up Load

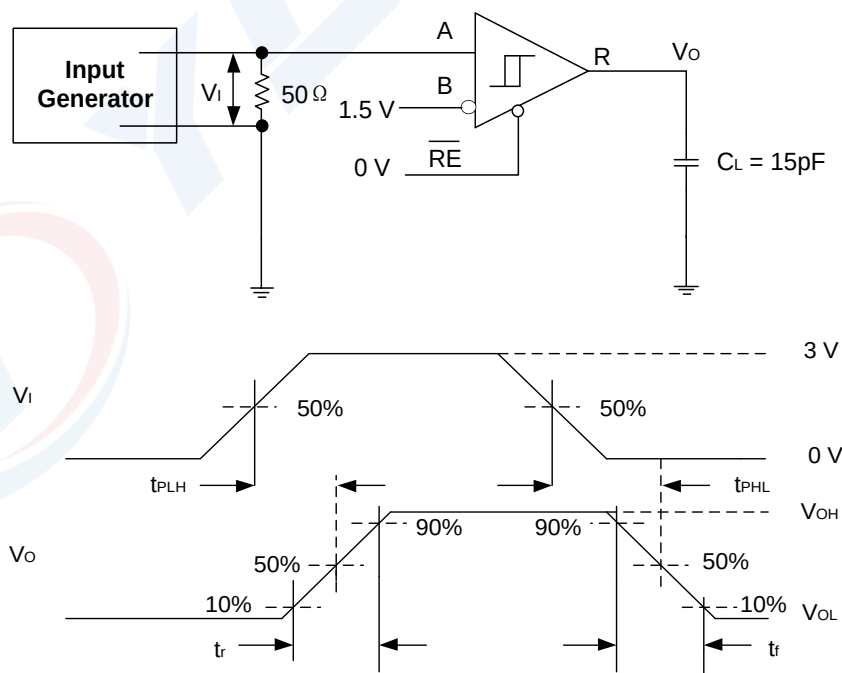


Figure 8-6. Measurement of Receiver Output Rise and Fall Times and Propagation Delays

8 Parameter Measurement Information (continued)

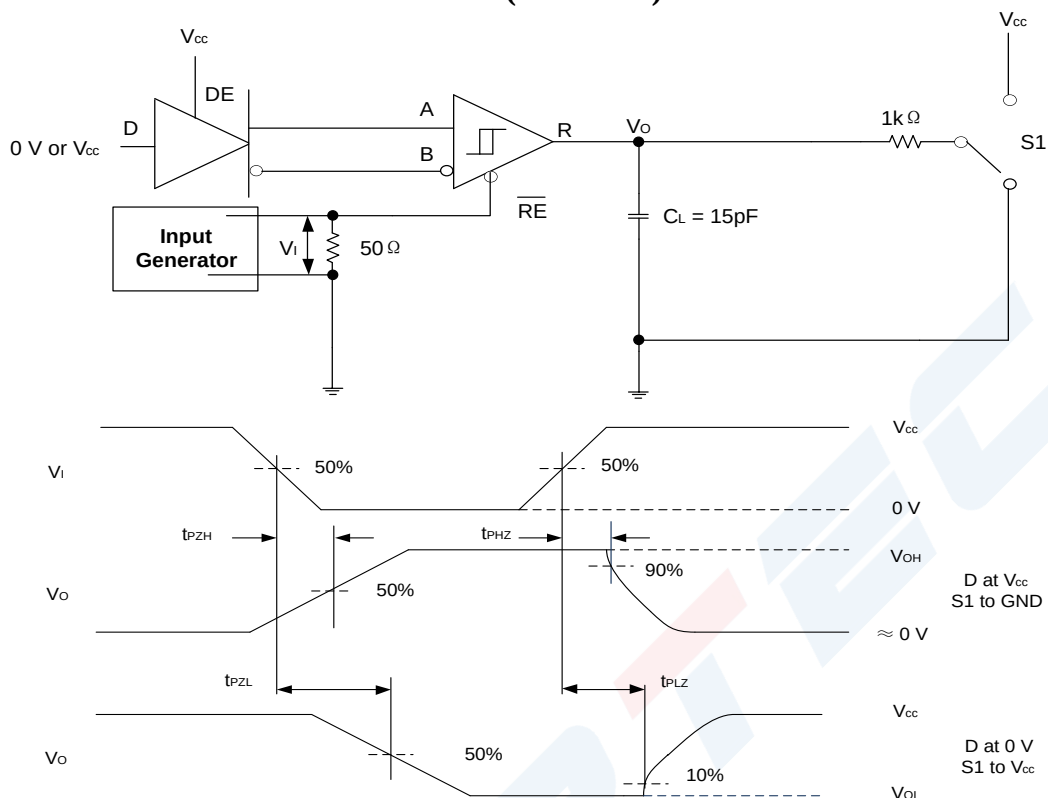


Figure 8-7. Measurement of Receiver Enable/Disable Times With Driver Enabled

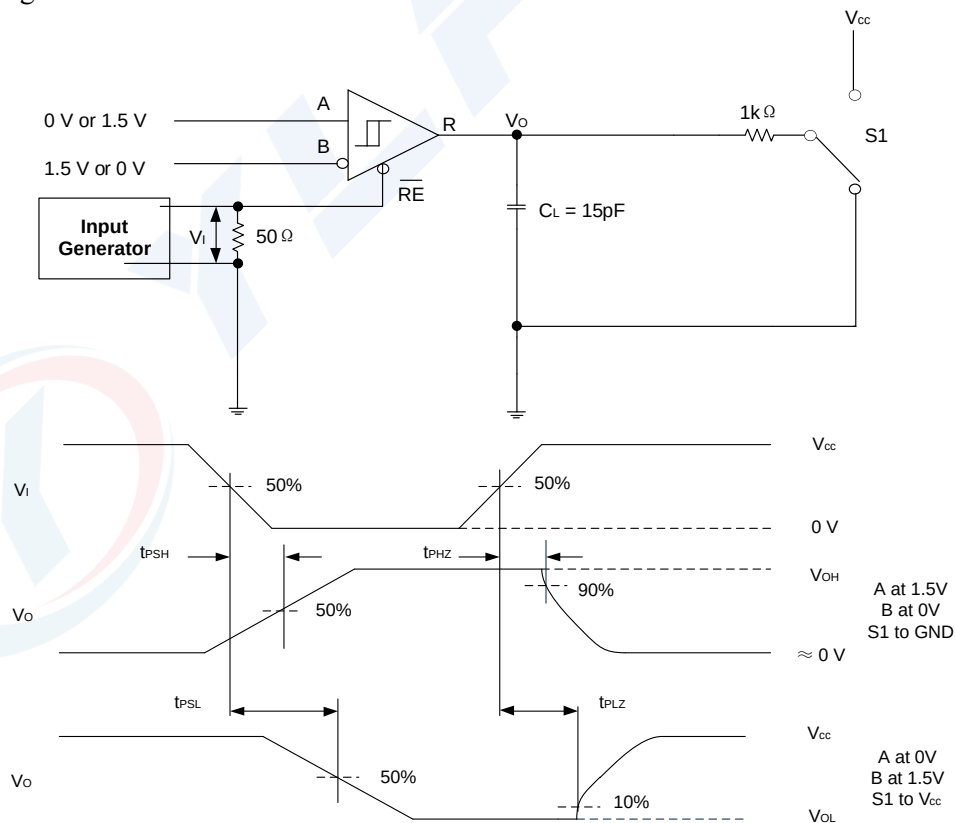


Figure 8-8. Measurement of Receiver Enable Times With Driver Disabled

8 Parameter Measurement Information(continued)

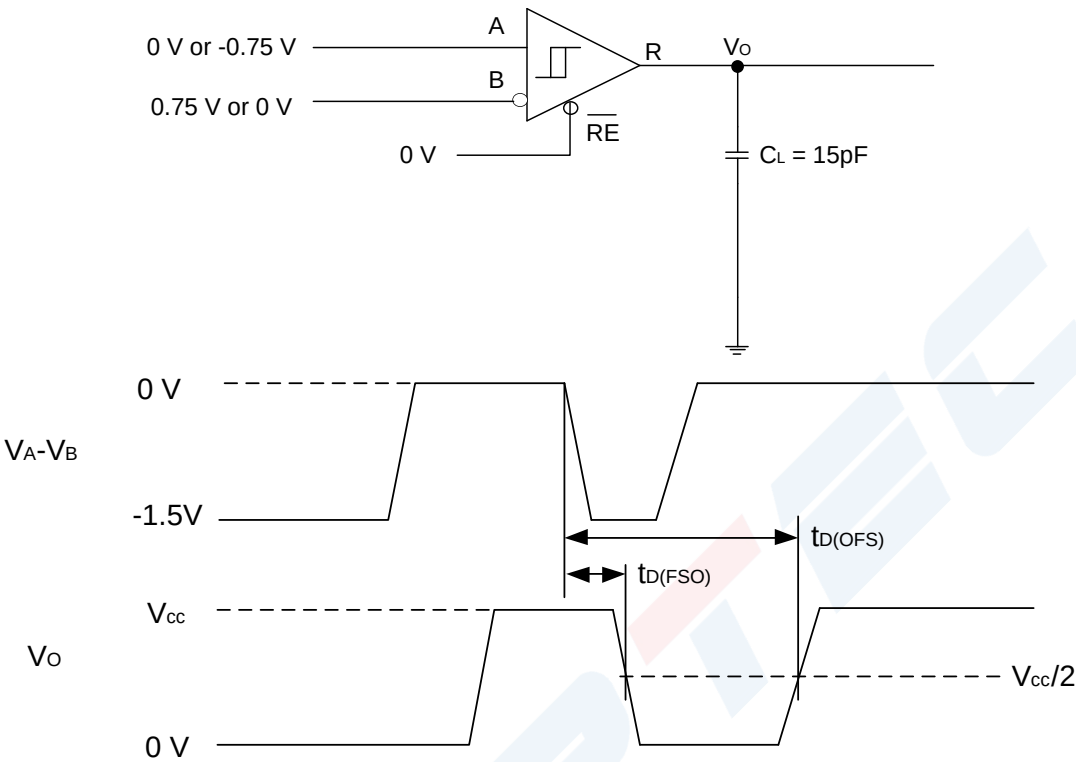


Figure 8-9. Measurement of Fail-Safe Delay

9 Detailed Description

9.1 Overview

SP3485EN-Y is a fault-protected, half-duplex RS-485 transceiver available in a speed grade suitable for data transmission up to 10 Mbps.

9.2 Functional Block Diagram

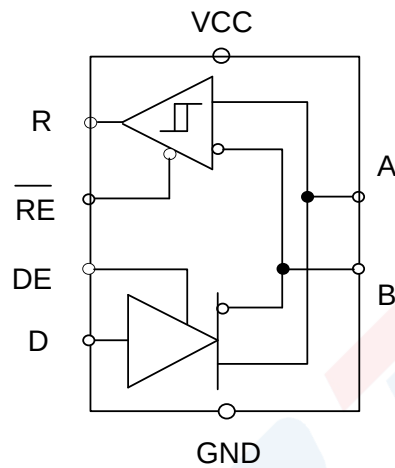


Figure 9-1. SP3485EN-Y Block Diagram

10 Feature Description

10.1 Receiver Fail-Safe Operation

The receiver is fail-safe to invalid bus states caused by the following:

- Open bus conditions, such as a disconnected connector

In any of these cases, the receiver outputs a fail-safe logic high state if the input amplitude stays for longer than $t_{D(OFS)}$ at less than $|V_{TH(FSH)}|$.

10.2 Low-Power Shutdown Mode

Driving DE low and $\overline{RE}$ high for longer than 500 ns puts the device into the shutdown mode. If either DE goes high or $\overline{RE}$ goes low, the counters reset. The device does not enter the shutdown mode if the enable pins are in disable state for less than 50 ns. This feature prevents the device from accidentally going into shutdown mode due to skew between DE and $\overline{RE}$.

10.3 Device Functional Modes

When the driver enable pin, DE, is logic high, the differential outputs A and B follow the logic states at data input D. A logic high at D causes A to turn high and B to turn low. In this case, the differential output voltage defined as $V_{OD} = V_A - V_B$ is positive. When D is low, the output states reverse: B turns high, A becomes low, and V_{OD} is negative.

When DE is low, both outputs turn high-impedance. In this condition, the logic state at D is irrelevant. The DE pin has an internal pull-down resistor to ground, thus when left open the driver is disabled (high-impedance) by default. The D pin has an internal pull-up resistor to V_{CC} , thus, when left open while the driver is enabled, output A turns high and B turns low.

Table 10-1. Driver Function Table

Enable	Input	Output		Function
		A	B	
H	H	H	L	Actively drive bus high
H	L	L	H	Actively drive bus low
H	Open	H	L	Actively drive bus high by default
L	X	Z	Z	Driver disabled
Open	X	Z	Z	Driver disabled by default

When the receiver enable pin, $\overline{RE}$, is logic low, the receiver is enabled. When the differential input voltage defined as $V_{ID} = V_A - V_B$ is higher than the positive input threshold, V_{TH+} , the receiver output, R, turns high. When V_{ID} is lower than the negative input threshold, V_{TH-} , the receiver output, R, turns low. If V_{ID} is between V_{TH+} and V_{TH-} , the output is indeterminate.

When $\overline{RE}$ is logic high or left open, the receiver output is high-impedance and the magnitude and polarity of V_{ID} are irrelevant. Internal biasing of the receiver inputs causes the output to go failsafe-high when the transceiver is disconnected from the bus (open-circuit), or the bus lines are shorted to one another (short-circuit), or the bus is not actively driven (idle bus).

10.3 Device Functional Modes (continued)

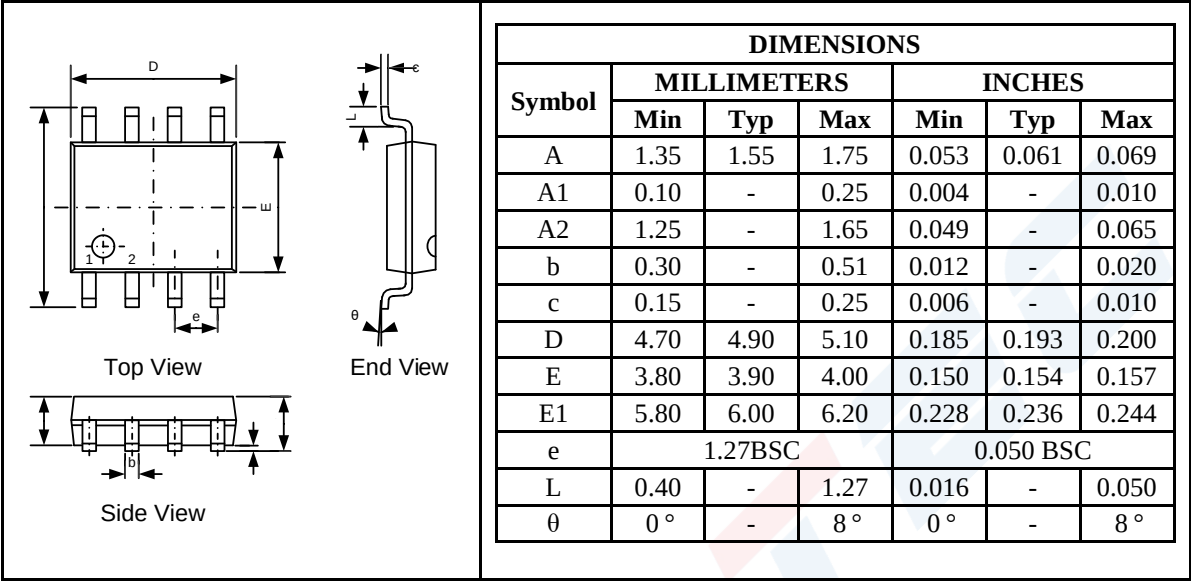
Table 10-2. Receiver Function Table

Enable	Differential Input	Output	Function
$\overline{\text{RE}}$	$V_{\text{ID}} = V_{\text{A}} - V_{\text{B}}$	R	
L	$V_{\text{TH}+} < V_{\text{ID}}$	H	Receive valid bus high
L	$V_{\text{TH-}} < V_{\text{ID}} < V_{\text{TH}+}$	N/A	Indeterminate bus state
L	$V_{\text{ID}} < V_{\text{TH-}}$	L	Receive valid bus low
L	Open-circuit bus	H	Fail-safe high output
L	Short-circuit bus	H	Fail-safe high output
L	Idle (terminated) bus	H	Fail-safe high output
H	X	Z	Receiver disabled
Open	X	Z	Receiver disabled by default

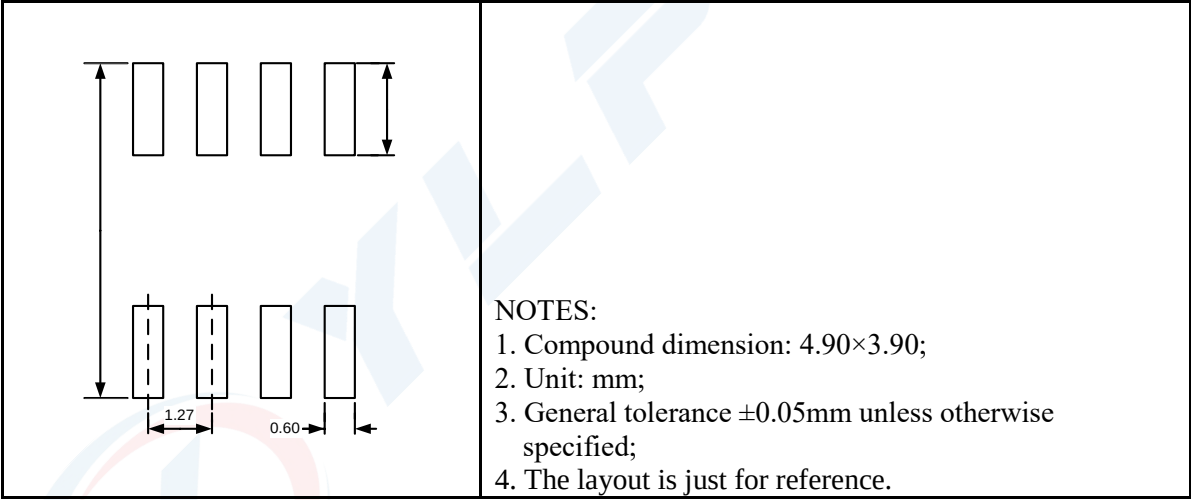
Package Information

SOP8

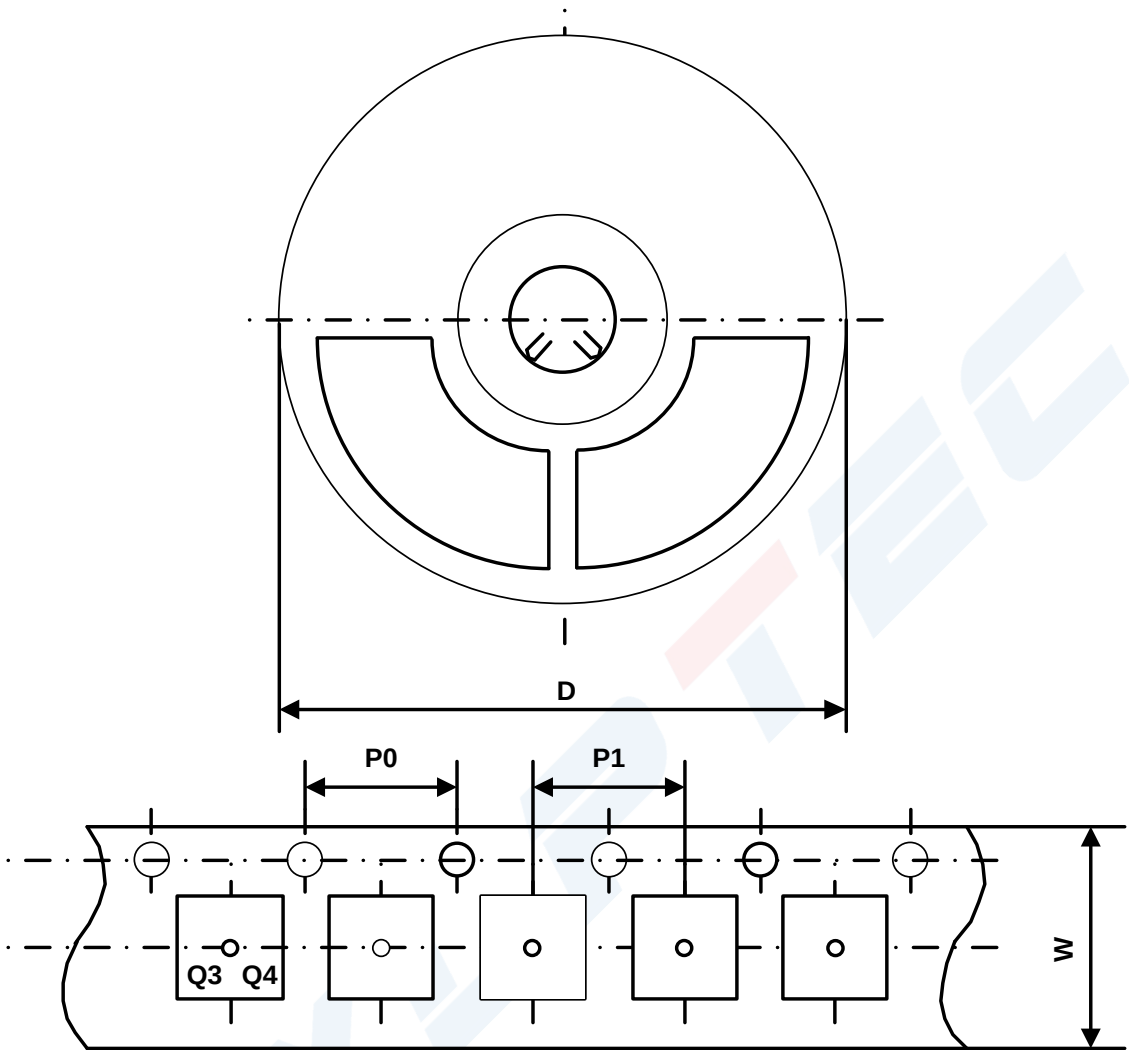
Outline Drawing



Land Pattern



Packing Information



Part Number	Package Type	Carrier Width (W)	Pitch (P0)	Pitch (P1)	Reel Size (D)	PIN 1 Quadrant
SP3485EN-Y	SOP8	12 mm	4 mm	8 mm	330 mm	Q1

GREEN COMPLIANCE

YLPTEC is committed to environmental excellence in all aspects of its operations including meeting or exceeding regulatory requirements with respect to the use of hazardous substances. Numerous successful programs have been implemented to reduce the use of hazardous substances and/or emissions.

All YLPTEC components are compliant with the RoHS directive, which helps to support customers in their compliance with environmental directives.

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