

# ±15-kV ESD Protected, 10-Mbps, Full Fail-Safe, RS-485 Transceivers

## Features

- High Data Rates: Up to 10 Mbps
- 35-ns Tx/Rx Propagation Delays
- 10-ns (Typ) Skew
- Full Fail-Safe (Open, Short, and Terminated) Receivers
- Up to 256 Nodes on a Bus (1/8 Unit Load)
- Wide Supply Voltage: 3 V to 5.5 V
- Low Quiescent Supply Current: 3 mA
- Bus-Pin Protection:
  - ±15-kV HBM Protection
  - ±15-kV IEC-ESD
- Pb-Free

## Applications

- PROFIBUS® DP and FMS Networks
- SCSI "Fast 40" Drivers and Receivers
- Motor Controller/Position Encoder Systems
- Factory Automation
- Field Bus Networks
- Industrial/Process Control Networks

## Description

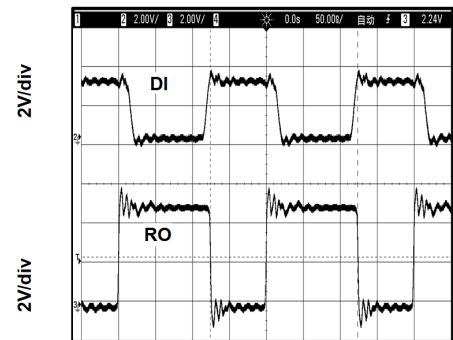
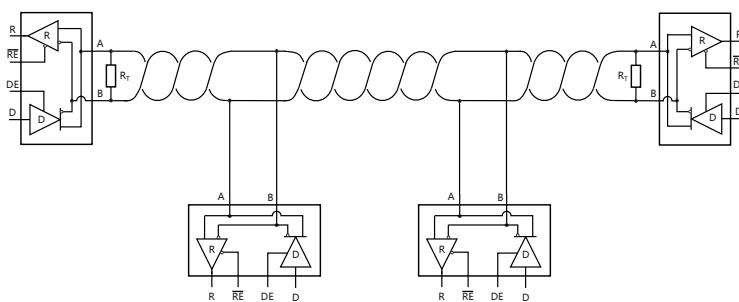
The SN485002 is an enhanced RS485 transceiver that exceeds the standard TIA/EIA-485-A with a ±15-kV ESD protected, 3-V to 5.5-V powered, and single transceiver for balanced communication. These devices also feature larger output voltages and higher data rates (up to 10 Mbps) required by high-speed PROFIBUS applications and are offered in industrial and extended industrial (–40°C to +125°C) temperature ranges.

These transceivers require a 3-V to 5.5-V tolerance supply and deliver at least a 2.1-V differential output voltage on a 5-V supply condition. This translates into better noise immunity (data integrity), longer reach, or the ability to drive up to three 120-Ω terminations in "star" or other non-standard bus topologies, at an exceptional 10-Mbps data rate.

The receiver (Rx) inputs feature a "Full Fail-Safe" design, which ensures a logic high Rx output if Rx inputs are floating, shorted, or terminated but undriven. Rx outputs feature high drive levels (typically >25 mA @  $V_{OL} = 1\text{ V}$ ) to ease the design of optically isolated interfaces.

The SN485002 is available in the SOP8 package, and is characterized from –40°C to 125°C.

## Typical Application Circuit



Time (50ns/div)  
**Loopback Test at 10 Mbps/5 V**

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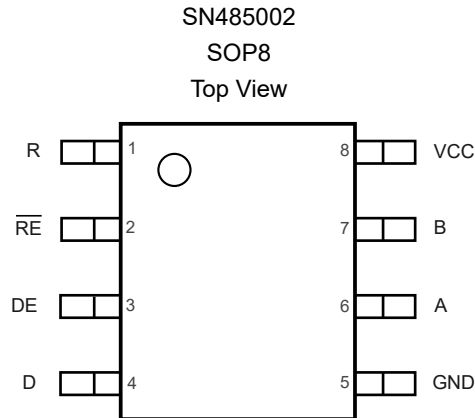
## Product Family Table

Part Number	Duplex	Data rate	HBM ESD	IEC-ESD	Package
SN485002	Half	10 Mbps	±15 kV	±15 kV	SOP8

## Revision History

Date	Revision	Notes
2024-09-19	Rev.A.0	Initial release
2025-04-22	Rev.A.1	Updated Features description

## Pin Configuration and Functions



**Table 1. Pin Functions: SN485002**

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	Noninverting Receiver Input A and Noninverting Driver Output A.
7	B	Bus input/output	Inverting Receiver Input B and Inverting Driver Output B.
8	VCC	Power	Power Supply.

## Specifications

### Absolute Maximum Ratings <sup>(1)</sup>

Parameter	Min	Max	Unit
V <sub>DD</sub> to GND	-0.3	7	V
Input Voltages DI, DE, $\overline{RE}$	-0.3	V <sub>CC</sub> + 0.3	V
Input/Output Voltages A, B	-9	14	V
A, B (Transient Pulse through 100 Ω)	-100	100	V
R <sub>o</sub>	-0.3	V <sub>CC</sub> + 0.3	V
Short Circuit Duration A, B		Continuous	

(1) Stresses beyond the Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions.

### ESD, Electrostatic Discharge Protection

Parameter		Condition	Minimum Level	Unit
HBM	Human Body Model, per ANSI/ESDA/JEDEC JS-001/ANSI/ESD STM5.5.1	RS-485 pins (A, B)	±15	kV
		All other pins	±4	kV
CDM	CDM, per ANSI/ESDA/JEDEC JS-002	RS-485	±1.5	kV

### Recommended Operating Conditions

Parameter		Min	Max	Unit
	Supply Voltage	3	5.5	V
T <sub>A</sub>	Operating Temperature Range	-40	125	°C
	Bus Pin Common-Mode Voltage Range	-7	12	V
T <sub>J</sub>	Maximum Junction Temperature (Plastic Package)		150	°C
T <sub>STG</sub>	Maximum Storage Temperature Range	-65	150	°C

### Thermal Information

Package Type	θ <sub>JA</sub>	θ <sub>JB</sub>	θ <sub>JC</sub>	Unit
SOP8	112.2	90.6	45.8	°C/W

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### Electrical Characteristics

All test conditions:  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$ V_{OD} $	Driver Differential-Output Voltage Magnitude	$R_L = 54\ \Omega$ $V_{CC} = 5\text{ V}$	2.3	2.5		V
		$R_L = 54\ \Omega$ with $V_A$ or $V_B$ from $-7$ to $+12\text{ V}$ , $V_{CC} = 5\text{ V}$ (RS-485)	2.2	2.4		
		$R_L = 54\ \Omega$ with $V_A$ or $V_B$ from $-7$ to $+12\text{ V}$ , $V_{CC} = 3\text{ V}$ (RS-485)	1.2	1.5		
$\Delta V_{OD} $	Change in Magnitude of Driver Differential-Output Voltage	$R_L = 54\ \Omega$ , $C_L = 50\text{ pF}$ , $V_{CC} = 5\text{ V}$	-0.2	-0.002	0.2	V
$V_{OC(SS)}$	Steady-State Common-Mode Output Voltage	Center of two 27- $\Omega$ load resistors		$V_{CC}/2$		V
$\Delta V_{OC}$	Change in Differential Driver Common-Mode Output Voltage		See Figure 1A	0.05		V
$V_{OC(PP)}$	Peak-to-Peak Driver Common-Mode Output Voltage			0.5		
$C_{OD}$	Differential Output Capacitance			8		pF
$V_{IT+}$	Positive-Going Receiver Differential-Input Voltage Threshold	$V_A$ or $V_B$ from $-5\text{ V}$ to $+7\text{ V}$		-50	-10	mV
$V_{IT-}$	Negative-Going Receiver Differential-Input Voltage Threshold	$V_A$ or $V_B$ from $-5\text{ V}$ to $+7\text{ V}$	-200	-130		mV
$V_{HYS}$	Receiver Differential-Input Voltage Threshold Hysteresis ( $V_{IT+} - V_{IT-}$ )			75		mV
$V_{IH}$	Logic Input High Voltage	DI, DE, $\overline{RE}$	2			V
$V_{IL}$	Logic Input Low Voltage	DI, DE, $\overline{RE}$			0.8	V
$V_{OH}$	Receiver High-Level Output Voltage	$I_{OH} = -8\text{ mA}$	4			V
$V_{OL}$	Receiver Low-Level Output Voltage	$I_{OL} = 8\text{ mA}$			0.4	V
$I_I$	Driver Input, Driver Enable and Receiver Enable Input Current	DI, DE, $\overline{RE}$	-2		2	$\mu\text{A}$

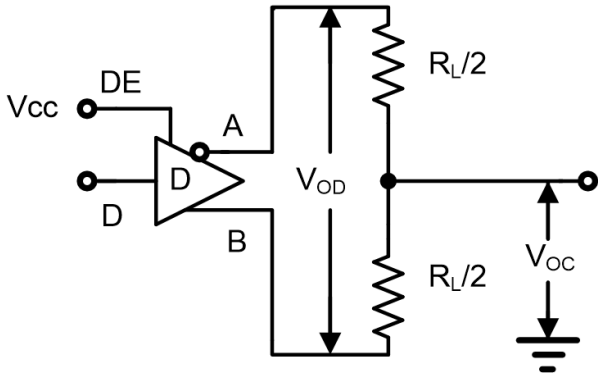
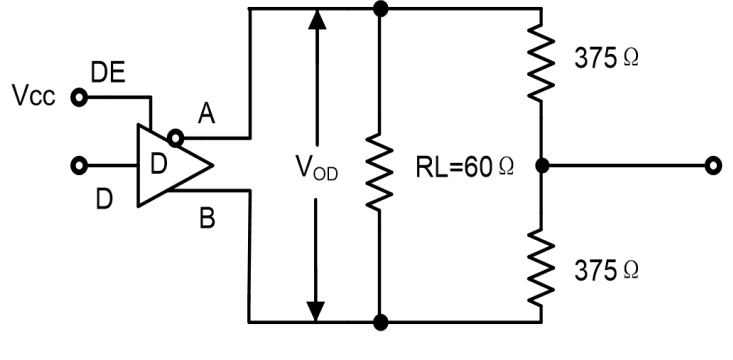
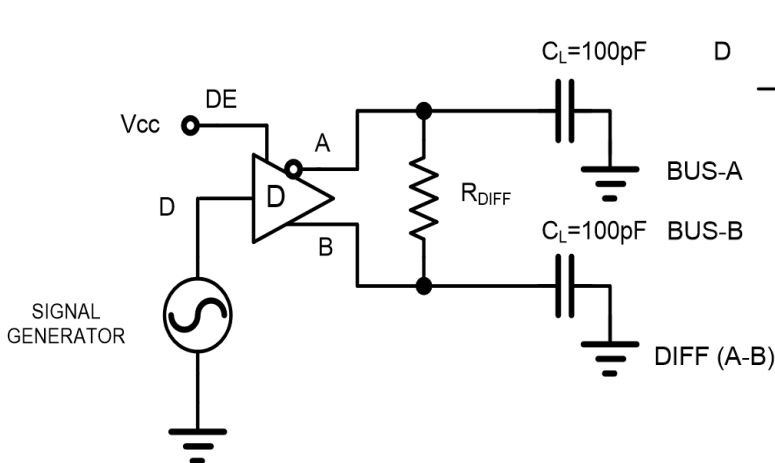
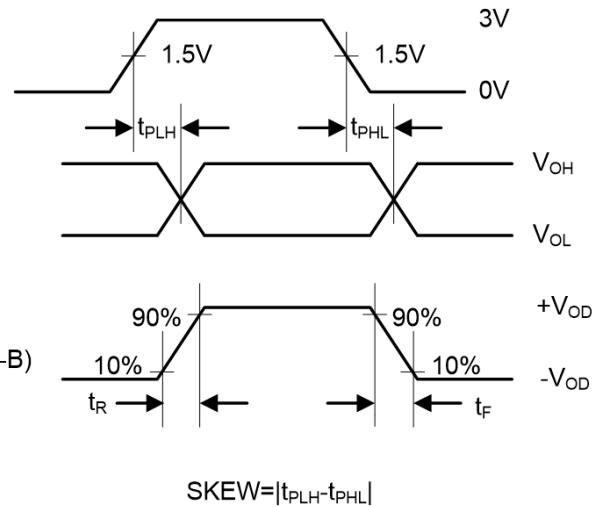
**±15-kV ESD Protected, 10-Mbps, Full Fail-Safe, RS-485  
Transceivers**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$I_{OZ}$	Receiver High-Impedance Output Current	$V_O = 0\text{ V}$ or $V_{CC}$ , $\overline{RE}$ at $V_{CC}$	-2		2	$\mu\text{A}$	
$ I_{OS} $	Driver Short-Circuit Output Current	$ I_{OS} $ with $V_A$ or $V_B$ from $-7\text{ V}$ to $+12\text{ V}$		120	300	mA	
$I_{IN}$	Bus Input Current (Driver Disabled)	$V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$ or $V_{CC} = 0\text{ V}$ , DE at $0\text{ V}$	$V_I = 12\text{ V}$			1	mA
			$V_I = -7\text{ V}$	-0.8			
$I_{CC}$	Supply Current (Quiescent)	Driver and receiver enabled	DE = $V_{CC}$ , $\overline{RE} = \text{GND}$ , no load		2.2	5	mA
		Driver enabled, receiver disabled	DE = $V_{CC}$ , $\overline{RE} = V_{CC}$ , no load		1.5	3	
		Driver disabled, receiver enabled	DE = GND, $\overline{RE} = \text{GND}$ , no load		0.5	1	
		Driver and receiver disabled	DE = GND, $\overline{RE} = V_{CC}$ , D = $V_{CC}$ , no load		0.1	0.5	

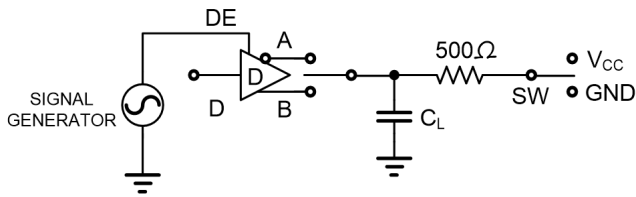
**Switching Characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b>Driver</b>							
f <sub>MAX</sub>	Maximum Data Rate	V <sub>OD</sub> ≥ ±1.5 V, R <sub>L</sub> = 54 Ω, C <sub>L</sub> = 100 pF (Figure 4)			10	Mbps	
t <sub>r</sub> , t <sub>f</sub>	Driver Differential-Output Rise and Fall Times	R <sub>L</sub> = 54 Ω, C <sub>L</sub> = 50 pF	See Figure 2		36	ns	
t <sub>PHL</sub> , t <sub>PLH</sub>	Driver Propagation Delay				35		45
t <sub>SK(P)</sub>	Driver Pulse Skew,  T <sub>PHL</sub> – T <sub>PLH</sub>				5		10
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Driver Disable Time		See Figure 3		70	90	ns
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Driver Enable Time	Receiver enabled			70	90	
		Receiver disabled			90	120	ns
<b>Receiver</b>							
t <sub>r</sub> , t <sub>f</sub>	Receiver Output Rise and Fall Times <sup>(1)</sup>	C <sub>L</sub> = 15 pF	see Figure 5		20	ns	
t <sub>PHL</sub> , t <sub>PLH</sub>	Receiver Propagation Delay Time				35		50
t <sub>SK(P)</sub>	Receiver Pulse Skew,  T <sub>PHL</sub> – T <sub>PLH</sub>				10		15
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Receiver Disable Time				45	60	ns
t <sub>PZL</sub> , t <sub>PZH</sub>	Receiver Enable Time	Driver enabled	see Figure 6		50	70	ns
	Receiver Enable Time	Driver disabled				70	90

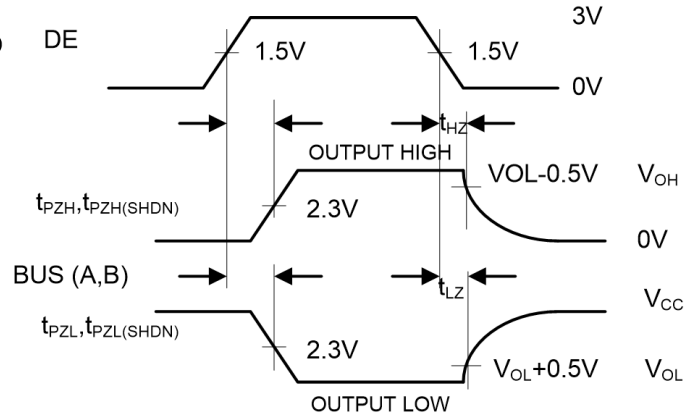
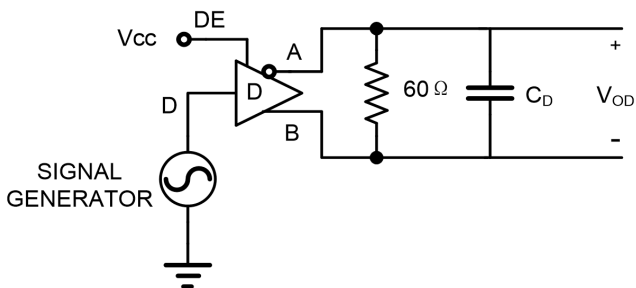
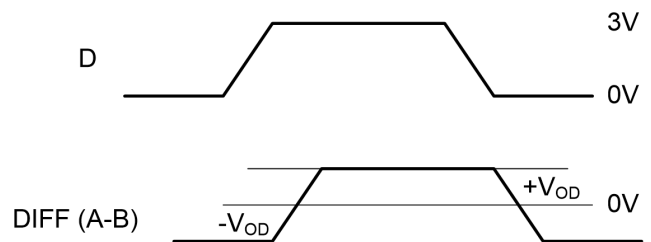
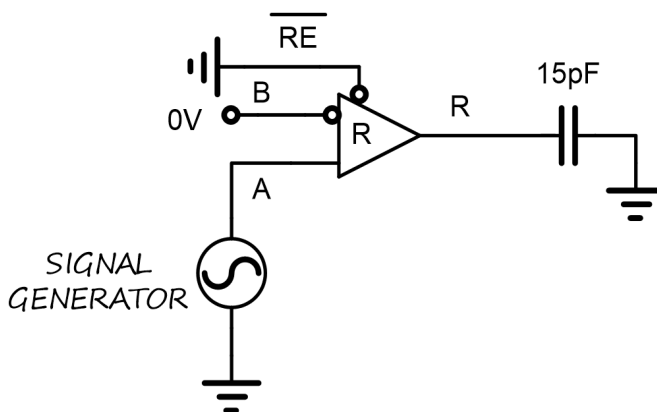
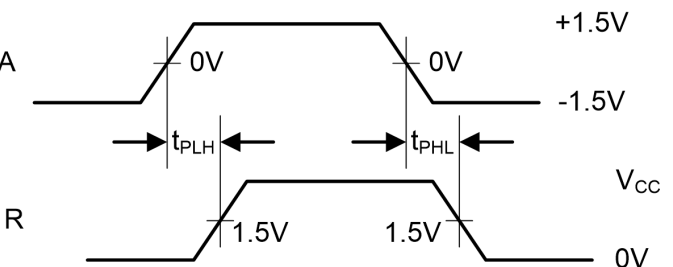


**Test Circuits and Waveforms**

**Figure 1A.  $V_{OD}$  and  $V_{OC}$** 

**Figure 1B.  $V_{OD}$  with Common-Mode Load**
**Figure 1. DC Driver Test Circuits**

**Figure 2A. Test Circuit**

**Figure 2B. Measurement Points**
**Figure 2. Driver Propagation Delay and Differential Transition Times**

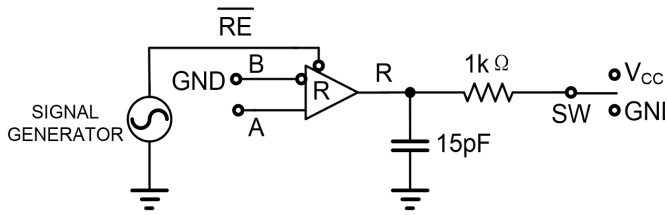
## ±15-kV ESD Protected, 10-Mbps, Full Fail-Safe, RS-485 Transceivers



PARAMETER	OUTPUT	RE	DI	SW	CL (pF)
tPHZ	A/B	X	1/0	GND	15
tPLZ	A/B	X	0/1	V <sub>CC</sub>	15
tPZH	A/B	0	1/0	GND	100
tPZL	A/B	0	0/1	V <sub>CC</sub>	100
tPZH(SHDN)	A/B	1	1/0	GND	100
tPZL(SHDN)	A/B	1	0/1	V <sub>CC</sub>	100

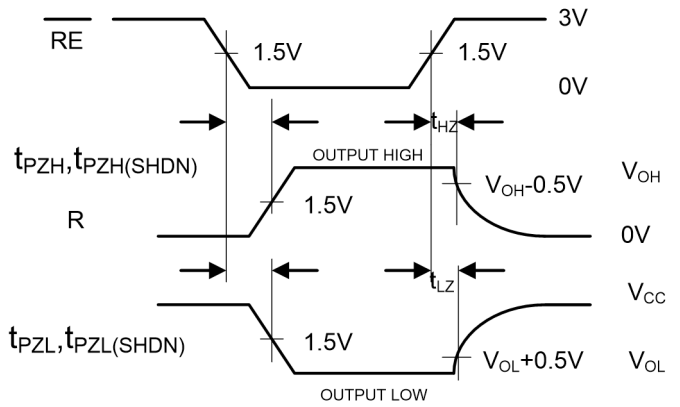
**Figure 3A. Test Circuit**

**Figure 3B. Measurement Points**
**Figure 3. Driver Enable and Disable Times**

**Figure 4A. Test Circuit**

**Figure 4B. Measurement Points**
**Figure 4. Driver Data Rate**

**Figure 5A. Test Circuit**

**Figure 5B. Measurement Points**
**Figure 5. Receiver Propagation Delay and Data Rate**

**±15-kV ESD Protected, 10-Mbps, Full Fail-Safe, RS-485 Transceivers**



PARAMETER	DE	A	SW
tPHZ	1	+1.5 V	GND
tPLZ	1	-1.5 V	V <sub>CC</sub>
tPZH	1	+1.5 V	GND
tPZL	1	-1.5 V	V <sub>CC</sub>
tPZH(SHDN)	0	+1.5 V	GND
tPZL(SHDN)	0	-1.5 V	V <sub>CC</sub>

**Figure 6A. Test Circuit**



**Figure 6B. Measurement Points**

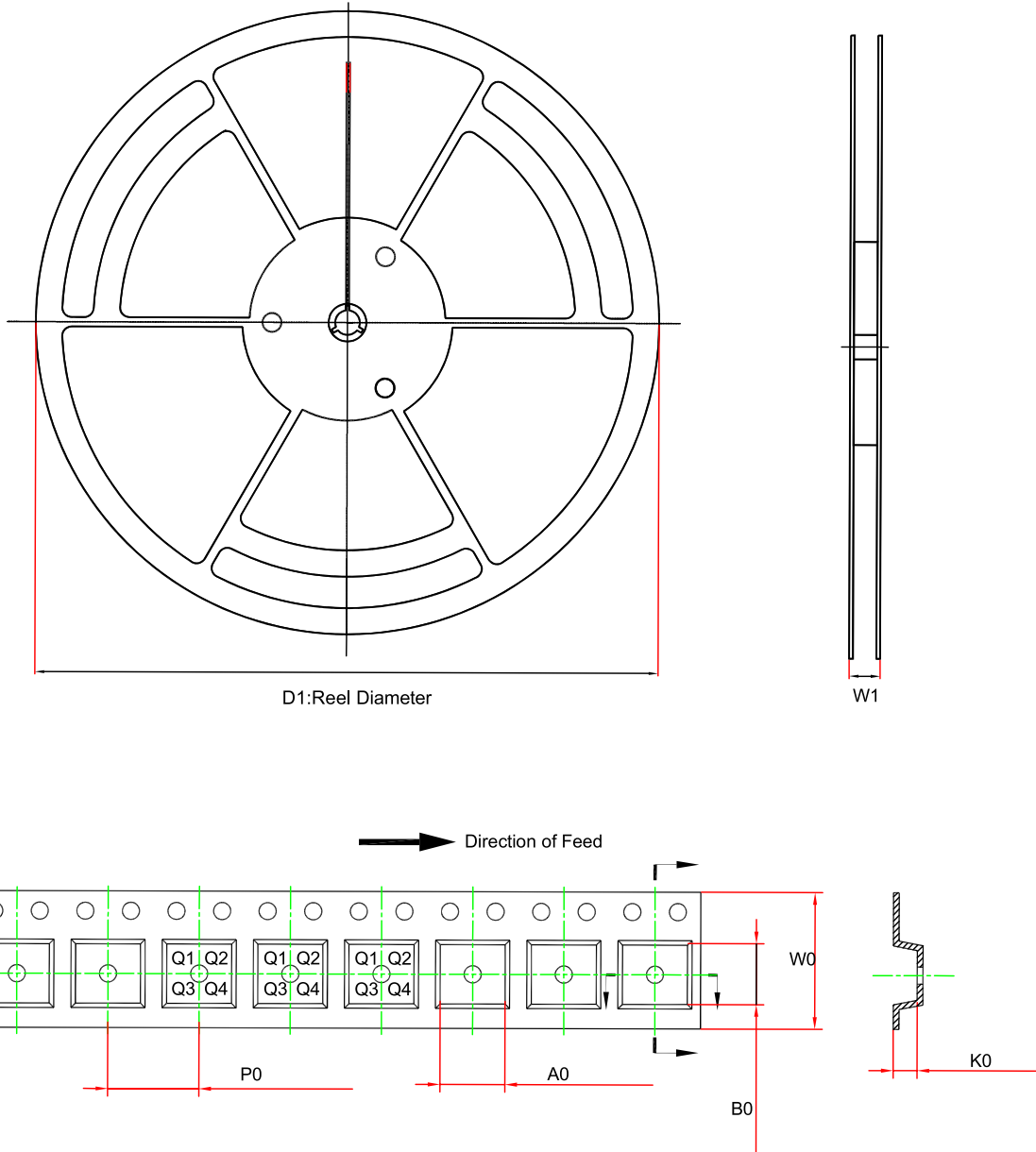
**Figure 6. Receiver Enable and Disable Times**

**Functional Table**
**Table 2. Driver Pin Functions**

Input	Enable	Outputs		Description
D	DE	A	B	
<b>Normal Mode</b>				
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

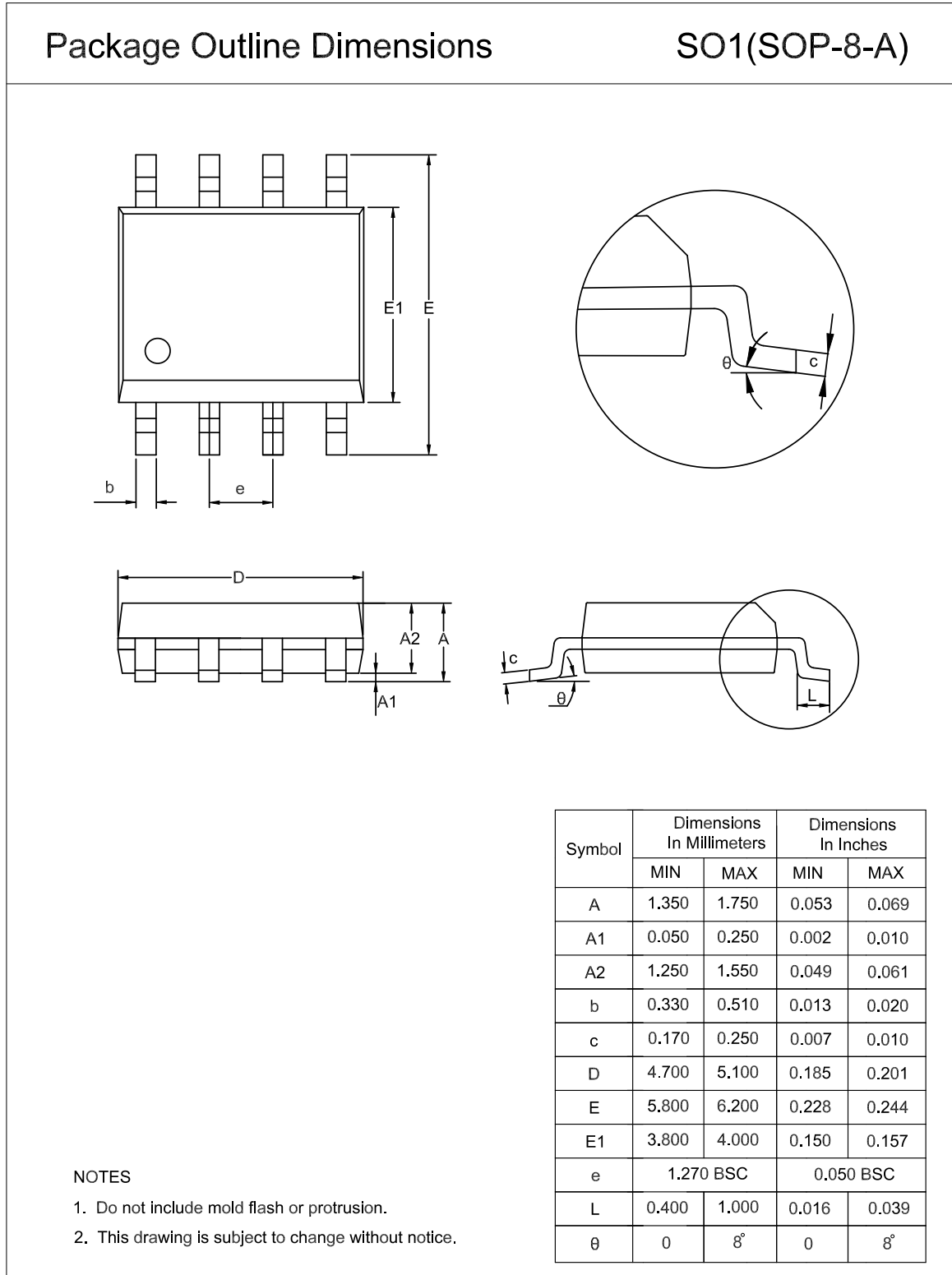
**Table 3. Receiver Pin Functions**

Differential Input	Enable	Output	Description
$V_{ID} = V_A - V_B$	$\overline{RE}$	R	
<b>Normal Mode</b>			
$V_{IT+} < V_{ID}$	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	Indeterminate bus state

**Tape and Reel Information**


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) <sup>(1)</sup>	B0 (mm) <sup>(1)</sup>	K0 (mm) <sup>(1)</sup>	P0 (mm)	W0 (mm)	Pin1 Quadrant
SN485002-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**


**Order Information**

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
SN485002-SO1R	-40 to 125°C	SOP8	485002	3	Tape and Reel, 4,000	Green

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

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