

钍地半导体
Tudi Semiconductor

Product Specification

TUDI-SN65LBC176

Differential bus transceiver

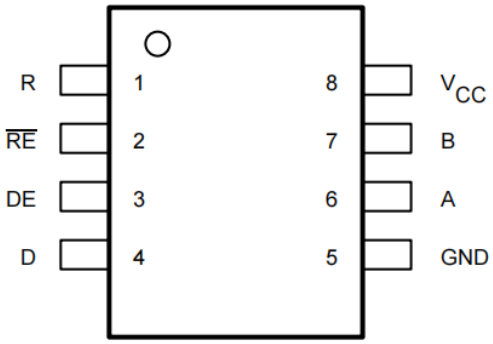
网址 www.sztdbdt.com

用芯智造·卓越品质

semiconductor device manufacturer

- Design
- research and development
- production
- and sales

Features



●Designed for signal transmission rates up to 30Mbps 1
● Bus pin ESD protection exceeds 12kV HBM
●Complies with ANSI standards TIA/EIA-485-A and ISO 8482:1987(E)
● Low skew
● Suitable for multi-point transmission on long-distance bus lines in noisy environments
●Ultra-low disabled supply current requirement: 700 mA (max)
●Common- voltage range of -7V to 12V
● Thermal shutdown protection
● Driver positive and negative current limiting
●Open-circuit fail-safe receiver design
● input sensitivity: ±200mV (max)
● Receiver input hysteresis: 50mV (typ)
●Interference-free power-up and power-down protection
●Suitable for Q-grade temperature automotive
– High-reliability automotive applications
– Supports configuration control/printing
– Automotive standard certified

Description

The SN65LBC176A, SN65LBC176AQ, and SN75L176A differential bus transceivers are monolithic integrated circuits designed for bidirectional data communication on multi-point bus transmission lines. These devices are designed for balanced transmission lines and comply with standards TIA/EIA-485-A and ISO 8482. Compared to previous generations, the A version provides higher switching performance without significantly increasing power consumption. The SN65LBC176A, SN65LBC176AQ, and SN75LBC176A integrate a three- differential line driver and a differential input line receiver, both of which are powered by a single 5V supply. The driver and receiver have high-level active and low-level active pins, respectively, which can be externally connected to be used for direction control. The driver differential outputs and receiver differential inputs are internally connected to form a differential input/output (I/O bus port, which provides a minimum load to the bus when the driver is disabled or VCC = 0. This port has a wide positive and negative common-mode voltage range, the device suitable for combined-line applications. Ultra-low device standby current can be achieved by disabling the driver and receiver.

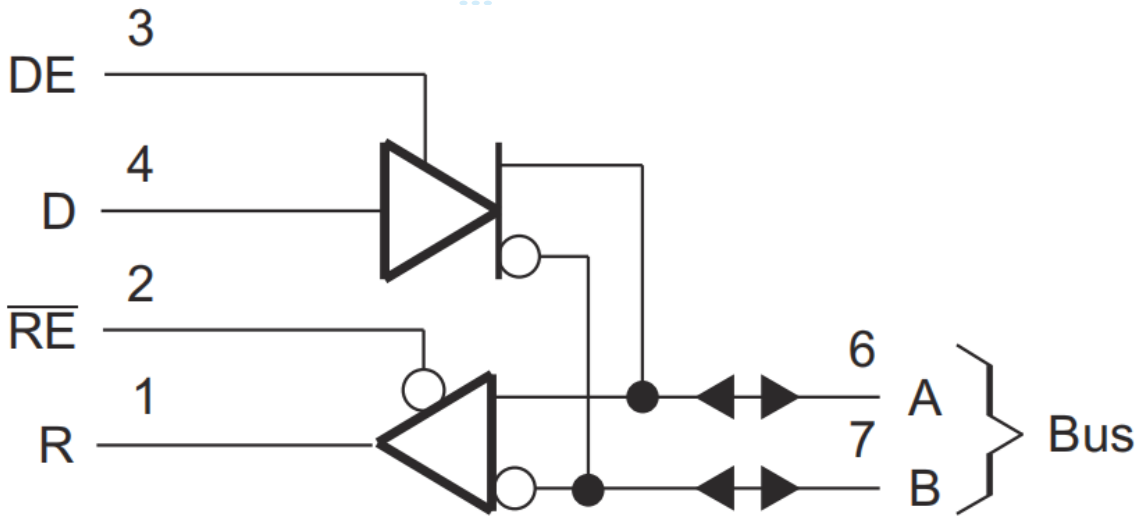


表 **4-1. Pin Functions**

NO	NAME	TYPE	DESCRIPTION
1	R	O	Receive data output
2	$\overline{RE}$	I	Receiver enable, active low
3	DE	I	Driver enable, active high
4	D	I	Driver data input
5	GND	GND	Device ground
6	A	I/O	Bus I/O port, A (complementary to B)
7	B	I/O	Bus I/O port, B(complementary to A)
8	V_{CC}	P	5 V Supply Pin

5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

		VALUE	UNIT
Supply voltage, V_{CC} (2)		- 0.3 to 6	V
Voltage range at any bus terminal (A or B)		- 10 to 15	V
Input voltage, V_I (D, DE, R, or $\overline{RE}$)		- 0.3 to V_{CC} + 0.5	V
Electrostatic discharge:	Bus terminals and GND, Class 3, A: (3)	12	kV
	Bus terminals and GND, Class 3, B: (3)	400	V
	All terminals, Class 3, A	3	kV
	All terminals, Class 3, B	400	V
Continuous total power dissipation(4)		See Dissipation Rating Table	
Storage temperature range, T_{stg}		- 65 to 150	°C

(1) Stresses beyond those listed under *absolute maximum ratings* 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 under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values, except differential I/O bus voltage, are with respect to network ground terminal.
(3) The maximum operating junction temperature is internally limited. Use the dissipation rating table to operate below this temperature.
(4) Tested in accordance with MIL-STD-883C, Method 3015.7

5.2 Dissipation Ratings

PACKAGE	$T_A \leq 25°C$ POWER RATING	DERATING FACTOR(1) ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING	$T_A = 125°C$ POWER RATING
D	725 mW	5.5 mW/°C	464 mW	377 mW	145 mW
P	1000 mW	8.0 mW/°C	640 mW	520 mW	—

(1) This is the inverse of the junction-to-ambient thermal resistance when board-mounted and with no air flow.

5.3 Recommended Operating Conditions

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		4.75	5	5.25	V
V_I or V_{IC}	Voltage at any bus terminal (separately or common mode)		- 7		12	V
V_{IH}	High-level input voltage	D, DE, and $\overline{RE}$	2		V_{CC}	V
V_{IL}	Low-level input voltage	D, DE, and $\overline{RE}$	0		0.8	V
V_{ID}	Differential input voltage(2)		- 12(1)		12	V
I_{OH}	High-level output current	Driver	- 60			mA
		Receiver	- 8			
I_{OL}	Low-level output current	Driver			60	mA
		Reciever			8	
T_A	Operating free-air temperature	SN65LBC176AQ	- 40		125	°C
		SN65LBC176A	- 40		85	
		SN75LBC176A	0		70	

(1) The algebraic convention, in which the least positive (most negative) limit is designated as minimum, is used in this data sheet.
(2) Differential input /output bus voltage is measured at the noninverting terminal A with respect to the inverting terminal B.

5.4 Thermal Information

THERMAL METRIC(1)		All Devices in 'P' Package	SN65LBC176ADR SN65LBC176AQDR	OPNs Not Listed in Previous Column	UNIT
		P (PDIP)	D (SOIC)	D (SOIC)	
		8-Pins	8-Pins	8-Pins	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	65.7	116.7	110	°C/W
$R_{\theta JC}$	Junction-to-case thermal resistance	54.7	56.3	44.1	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	42.1	63.4	53.5	°C/W
ψ_{JT}	Junction-to-top characterization parameter	23	8.8	4.8	°C/W
ψ_{JB}	Junction-to-board characterization parameter	41.7	62.9	52.7	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC package thermal metrics* application report.

5.5 Driver Electrical Characteristics

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP(1)	MAX	UNIT
V_{IK}	Input clamp voltage	I_I = − 18 mA			− 1.5	− 0.8		V
$\lvert V_{OD} \rvert$	Differential output voltage	I_O = 0		SN65LBC176AQ	1.5	4	6	V
				SN65LBC176A, SN75LBC176A		4		
		R_L = 54 Ω,	See 图 6-1	SN65LBC176AQ	0.9	1.5	6	V
				SN65LBC176A	1	1.5	3	
				SN75LBC176A	1.1	1.5	3	
		V_{test} = − 7 to 12 V,	See 图 6-2	SN65LBC176AQ	0.9	1.5	6	V
				SN65LBC176A	1	1.5	3	
				SN75LBC176A	1.1	1.5	3	
$\Delta \lvert V_{OD} \rvert$	Change in magnitude of differential output voltage	See 图 6-1 and 图 6-2			− 0.2		0.2	V
$V_{OC(SS)}$	Steady-state common-mode output voltage	See 图 6-1		SN65LBC176AQ	1.8	2.4	3	V
				SN65LBC176A, SN75LBC176A	1.8	2.4	2.8	
$\Delta V_{OC(SS)}$	Change in steady-state common-mode output voltage			SN65LBC176AQ	− 0.2		0.2	V
				SN65LBC176A, SN75LBC176A	− 0.1		0.1	
I_{OZ}	High-impedance output current	See receiver input currents						
I_{IH}	High-level enable input current	V_I = 2 V			− 100			µA
I_{IL}	Low-level enable input current	V_I = 0.8 V			− 100			µA
I_{OS}	Short-circuit output current	− 7 V ≤ V_O ≤ 12 V			− 250		250	mA
I_{CC}	Supply current	V_I = 0 or V_{CC}, No load	Receiver disabled and driver enabled			5	9	mA
			Receiver disabled and driver disabled			0.4	0.7	
			Receiver enabled and driver enabled			8.5	15	

(1) All typical values are at V_{CC} = 5 V, T_A = 25°C.

5.6 Driver Switching Characteristics

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	SN65LBC176AQ			SN65LBC176A SN75LBC176A			UNIT
			MIN	TYP(1)	MAX	MIN	TYP(1)	MAX	
t_{PLH}	Propagation delay time, low-to-high-level output	R_L = 54 Ω, C_L = 50 pF, See 图 6-3	2		12	2	6	12	ns
t_{PHL}	Propagation delay time, high-to-low-level output		2		12	2	6	12	ns
$t_{sk(p)}$	Pulse skew ($\lvert t_{PLH} - t_{PHL} \rvert$)				2		0.3	1	ns
t_r	Differential output signal rise time		1.2		11	4	7.5	11	ns
t_f	Differential output signal fall time		1.2		11	4	7.5	11	ns
t_{PZH}	Propagation delay time, high-impedance-to-high-level output	R_L = 110 Ω, See 图 6-4			22		12	22	ns
t_{PZL}	Propagation delay time, high-impedance-to-low- level output	R_L = 110 Ω, See 图 6-5			25		12	22	ns
t_{PHZ}	Propagation delay time, high-level-to-high- impedance output	R_L = 110 Ω, See 图 6-4			22		12	22	ns
t_{PLZ}	Propagation delay time, low-level-to-high- impedance output	R_L = 110 Ω, See 图 6-5			22		12	22	ns

(1) All typical values are at V_{CC} = 5 V, T_A = 25°C.

5.7 Receiver Electrical Characteristics

over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP(1)	MAX	UNIT
V_{IT+}	Positive-going input threshold voltage	I_O = - 8 mA					0.2	V
V_{IT-}	Negative-going input threshold voltage	I_O = 8 mA			- 0.2			V
V_{hys}	Hysteresis voltage (VIT + - VIT -)					50		mV
V_{IK}	Enable-input clamp voltage	II = - 18 mA			- 1.5	- 0.8		V
V_{OH}	High-level output voltage	V_{ID} = 200 mV,	I_{OH} = - 8 mA,	See 图 6-6	4	4.9		V
V_{OL}	Low-level output voltage	V_{ID} = - 200 mV,	I_{OH} = 8 mA,	See 图 6-6		0.1	0.8	V
I_{OZ}	High-impedance-state output current	V_O = 0 to V_{CC}		SN65LBC176AQ	- 10		10	μA
				SN65LBC176A, SN75LBC176A	- 1		1	
I_I	Bus input current	V_{IH} = 12 V,	V_{CC} = 5 V	Other input at 0 V		0.4	1	mA
		V_{IH} = 12 V,	V_{CC} = 0			0.5	1	
		V_{IH} = - 7 V,	V_{CC} = 5 V		- 0.8	- 0.4		
		V_{IH} = - 7 V,	V_{CC} = 0		- 0.8	- 0.3		
I_{IH}	High-level enable-input current	V_{IH} = 2 V			- 100			μA
I_{IL}	Low-level enable-input current	V_{IL} = 0.8 V			- 100			μA
I_{CC}	Supply current	V_I = 0 or V_{CC}, No load	Receiver enabled and driver disabled			4	7	mA
			Receiver disabled and driver disabled			0.4	0.7	
			Receiver enabled and driver enabled			8.5	15	

(1) All typical values are at V_{CC} = 5 V, T_A = 25°C.

5.8 Receiver Switching Characteristics

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	SN65LBC176AQ			SN65LBC176A SN75LBC176A			UNIT
			MIN	TYP(1)	MAX	MIN	TYP(1)	MAX	
t_{PLH}	Propagation delay time output ↑	V_{ID} = – 1.5 V to 1.5 V, See 图 6-7	7		30	7	13	20	ns
t_{PHL}	Propagation delay time output ↓		7		30	7	13	20	ns
$t_{sk(p)}$	Pulse skew (| t_{PLH} – t_{PHL} |)				6		0.5	1.5	ns
t_r	Rise time, output	See 图 6-7			5		2.1	3.3	ns
t_f	Fall time, output				5		2.1	3.3	ns
t_{PZH}	Output enable time to high level	C_L = 10 pF, See 图 6-8			50		30	45	ns
t_{PZL}	Output enable time to low level				50		30	45	ns
t_{PHZ}	Output disable time to high level				60		20	40	ns
t_{PLZ}	Output disable time to low level				60		20	40	ns

(1) All typical values are at V_{CC} = 5 V, T_A = 25°C.

参数测量信息

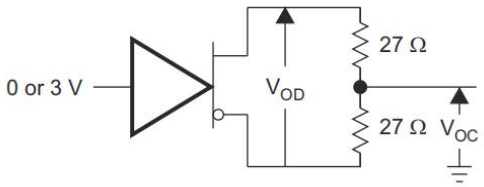


图 **6-1.** 驱动器 V_{OD} 和 V_{OC}

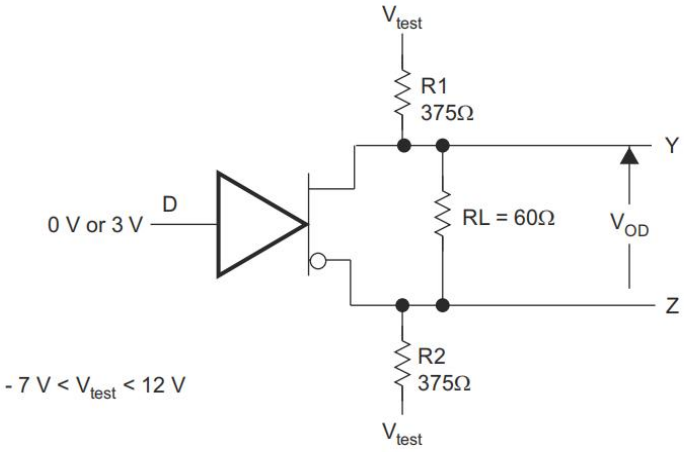
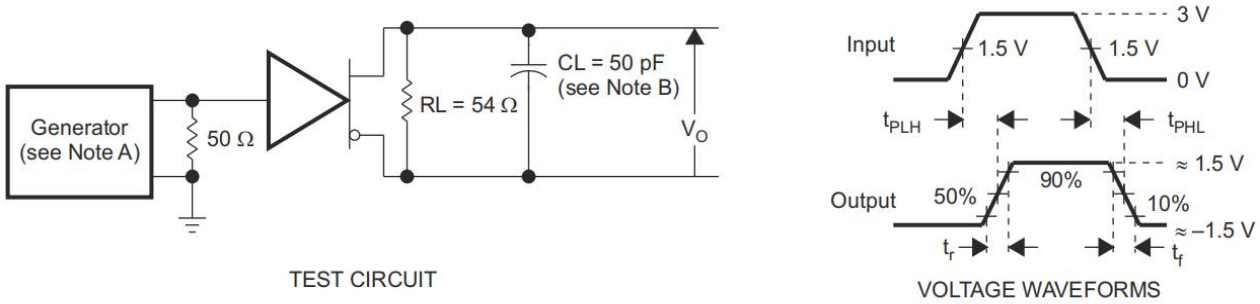


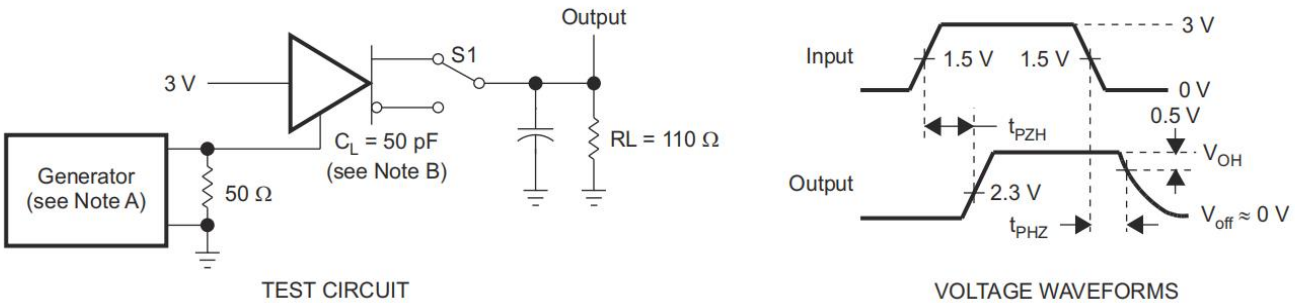
图 **6-2.** 驱动器 V_{OD3}



A. 输入脉冲由具有以下特性的发生器提供：PRR ≤ 1MHz，50% 占空比，t_r ≤ 6ns，t_f ≤ 6ns，Z_O = 50Ω。

B. C_L 包括探头和夹具电容。

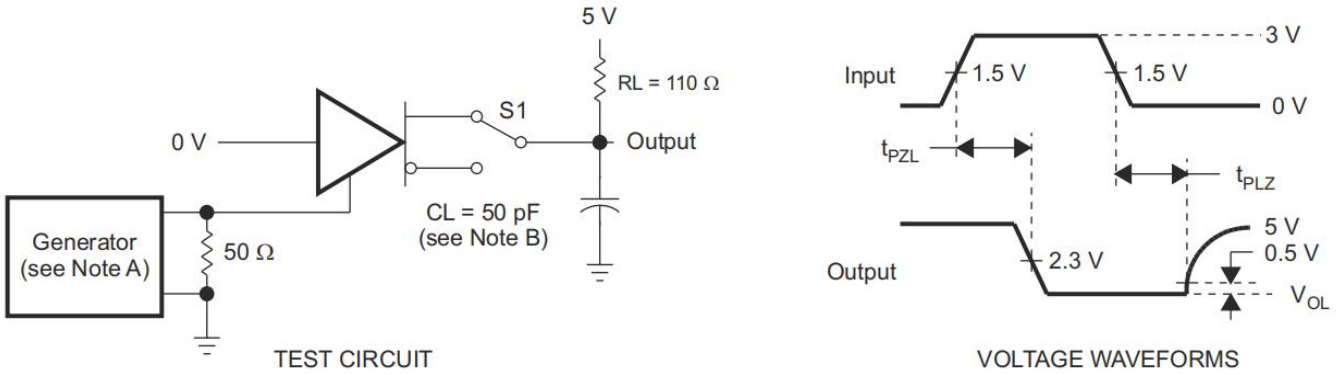
图 **6-3.** 驱动器测试电路和电压波形



A. 输入脉冲由具有以下特性的发生器提供：PRR ≤ 1MHz，50% 占空比，t_r ≤ 6ns，t_f ≤ 6ns，Z_O = 50Ω。

B. C_L 包括探头和夹具电容。

图 **6-4.** 驱动器测试电路和电压波形



A. 输入脉冲由具有以下特性的发生器提供：PRR ≤ 1MHz，50% 占空比，t_r ≤ 6ns，t_f ≤ 6ns，Z_O = 50Ω。

B. C_L 包括探头和夹具电容。

图 6-5. 驱动器测试电路和电压波形

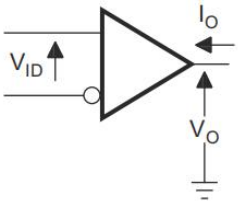
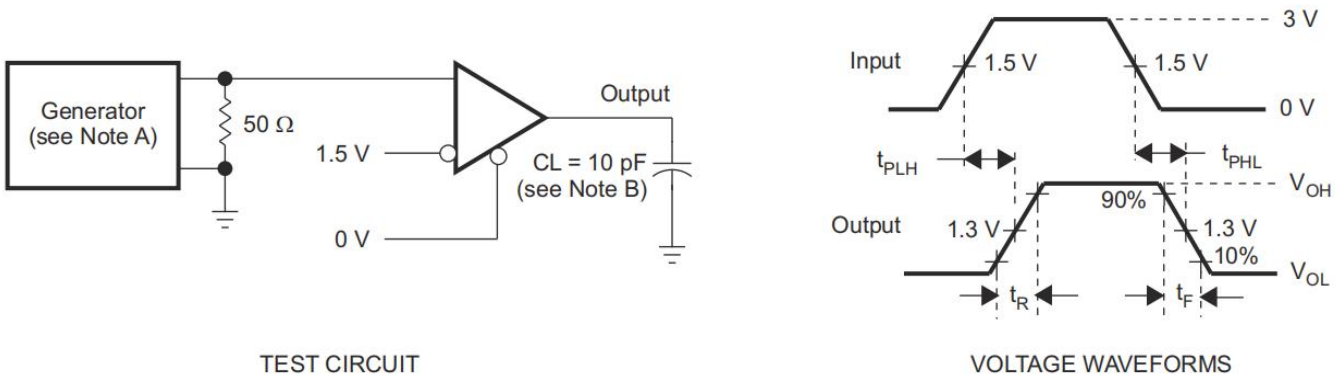


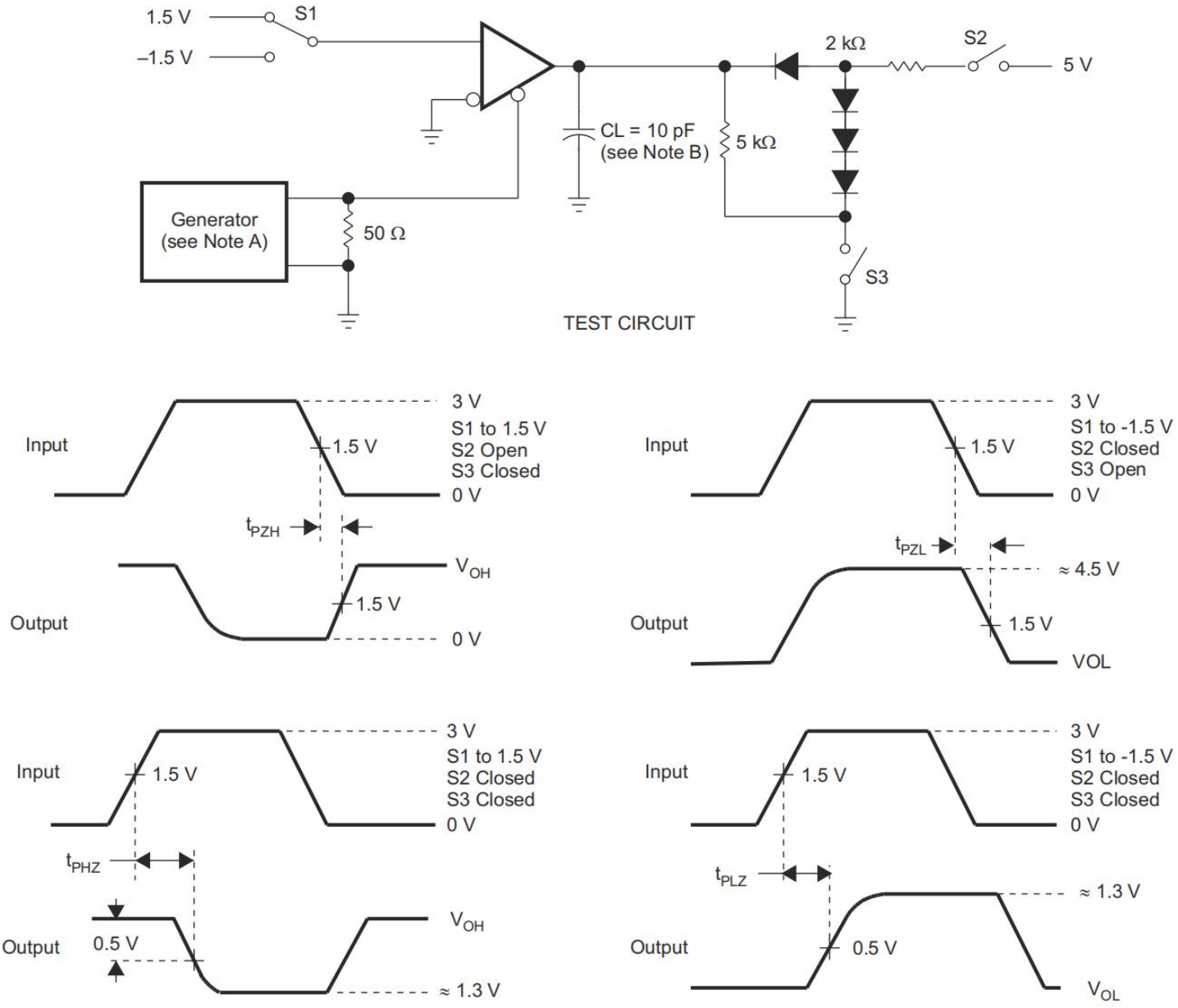
图 6-6. 接收器 V_{OH} 和 V_{OL}



A. 输入脉冲由具有以下特性的发生器提供：PRR ≤ 1MHz，50% 占空比，t_r ≤ 6ns，t_f ≤ 6ns，Z_O = 50Ω。

B. C_L 包括探头和夹具电容。

图 6-7. 接收器测试电路和电压波形



VOLTAGE WAVEFORMS

A. 输入脉冲由具有以下特性的发生器提供：PRR ≤ 1MHz，50% 占空比，t_r ≤ 6ns，t_f ≤ 6ns，Z_O = 50Ω。

B. C_L 包括探头和夹具电容。

图 6-8. 接收器测试电路和电压波形

6 Detailed Description

6.1 Device Functional Modes

6.1.1 Function Tables

DRIVER			
INPUT D	ENABLE DE	OUTPUTS A	OUTPUTS B
H	H	H	L
L	H	L	H
X	L	Z	Z
Open	H	H	L

RECEIVER		
DIFFERENTIAL INPUTS $V_A - V_B$	ENABLE(1) $\overline{RE}$	OUTPUT(1) R
$V_{ID} \geq 0.2$ V	L	H
-0.2 V $< V_{ID} < 0.2$ V	L	?
$V_{ID} \leq -0.2$ V	L	L
X	H	Z
Open	L	H

(1) H = high level, L - low level, ? = indeterminate, X = Irrelevant, Z = high impedance (off)

6.1.2 Schematics

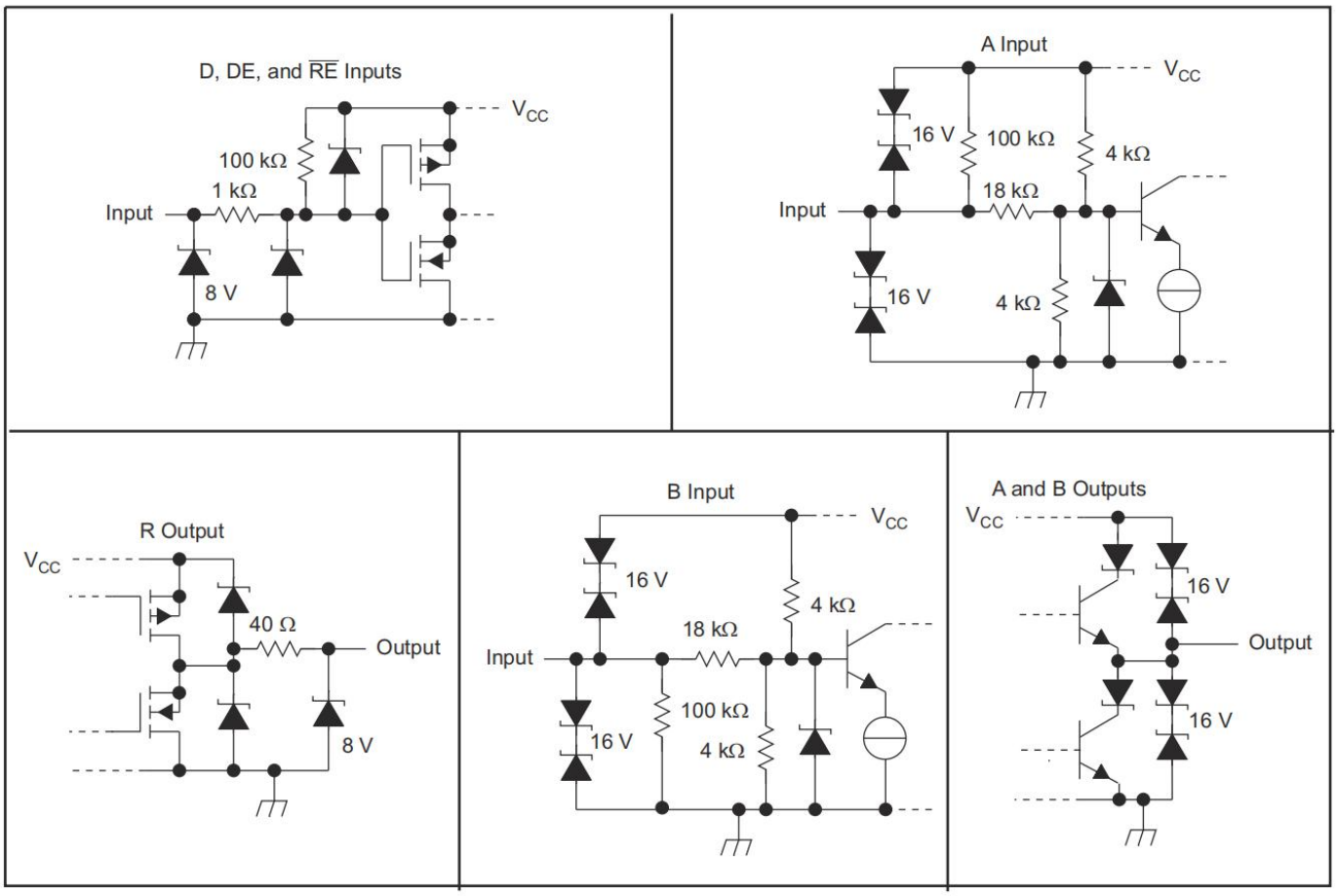
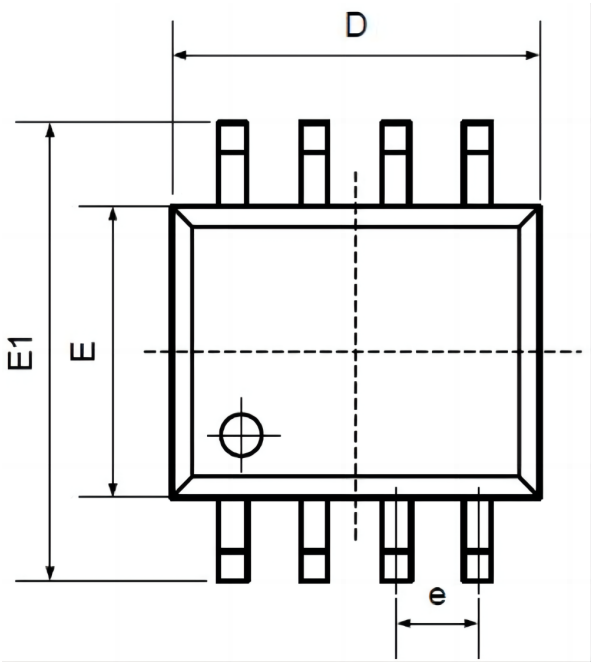


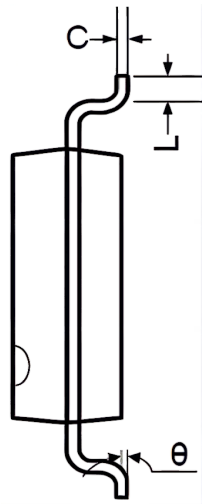
图 6-1. Schematics of Inputs and Outputs

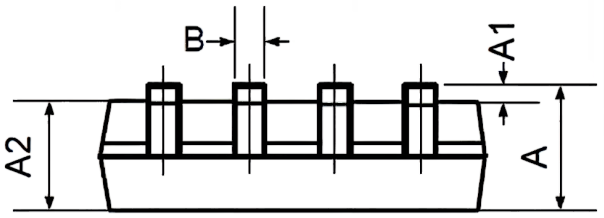
Order information

Order Number	Package	Package Quantity	Marking On The park
SN65LBC176ADR-TUDI	SOP8	Tape,Reel,2500	SN65LBC176ADR
SN65LBC176DR-TUDI	SOP8	Tape,Reel,2500	SN65LBC176DR
SN65LBC176P-TUDI	DIP8	Tube,50,A box of 2000	SN65LBC176P
SN65LBC176QDR-TUDI	SOP8	Tape,Reel,2500	SN65LBC176QDR

Package SOP8

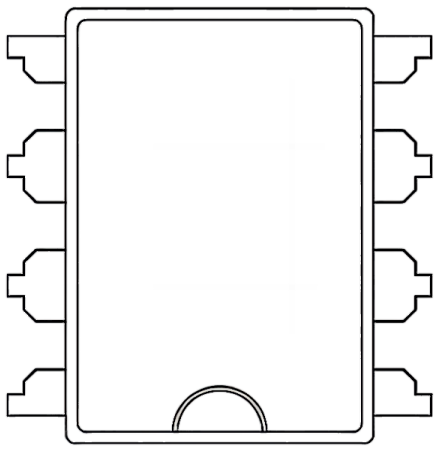


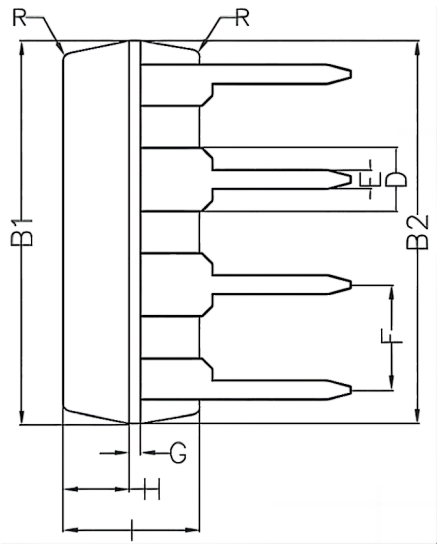


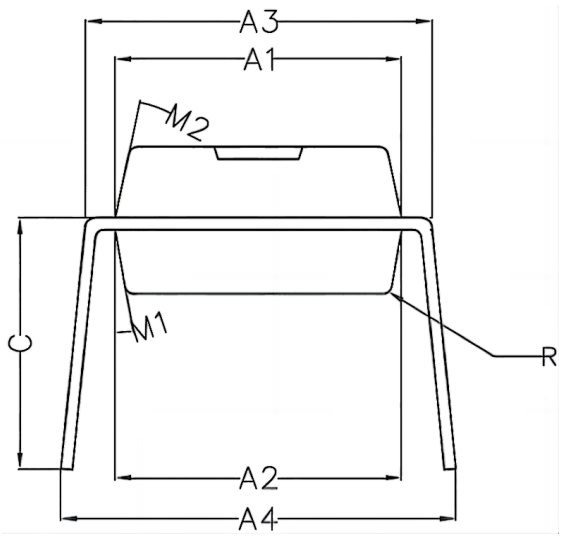


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
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
工	3.22	3.27	3.32
R		0.20	
M1	9°	10°	11°
M2	11°	12°	13°

Important statement:

●TUDI Semiconductor reserves the right to modify the product manual without prior notice! Before placing an order, customers need to confirm whether the obtained information is the latest version and verify the completeness of the relevant information.

●Any semi-guide product is subject to failure or malfunction under specified conditions. It is the buyer's responsibility to comply with safety standards when using TUDI Semiconductor products for system design and whole machine manufacturing.And take the appropriate safety measures to avoid the potential in the risk of loss of personal injury or loss of property situation!

●TUDI Semiconductor products have not been licensed for life support, military, and aerospace applications,and therefore TUDI Semiconductor is not responsible for any consequences arising from the use of this product in these areas.

●If any or all TUDI Semiconductor products (including technical data, services) described or contained in this document are subject to any applicable local export control laws and regulations, they may not be exported without an export license from the relevant authorities in accordance with such laws.

●The specifications of any and all TUDI Semiconductor products described or contained in this document specify the performance, characteristics, and functionality of said products in their standalone state, but do not guarantee the performance, characteristics, and functionality of said products installed in Customer's products or equipment. In order to verify symptoms and conditions that cannot be evaluated in a standalone device, the Customer should ultimately evaluate and test the device installed in the Customer's product device.

●TUDI Semiconductor documentation is only allowed to be copied without any alteration of the content and with the relevant authorization.TUDI Semiconductor assumes no responsibility or liability for altered documents.

●TUDI Semiconductor is committed to becoming the preferred semiconductor brand for customers, and TUDI Semiconductor will strive to provide customers with better performance and better quallity products.