钍地半导体
Tudi Semiconductor

Product Specification

TUDI-ISL3159E

±15kV ESD Protected, +125 ° C, 40Mbps, 5V, PROFIBUS, Full Fail-Safe, RS-485/RS-422 Transceiver

网址 www.sztdbdt.com

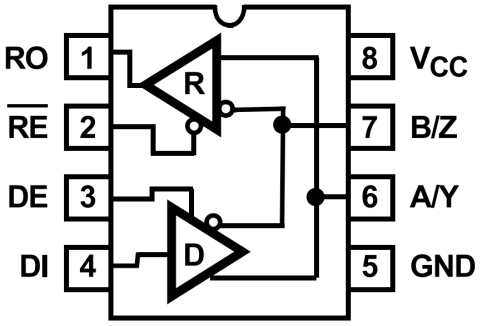
用芯智造·卓越品质

semiconductor device manufacturer

- Design
- research and development
- production
- and sales

Features

●IEC61000 ESD protection on RS-485 I/O pins . . . . . ±15kV
- Class 3 HBM ESD level on all other pins . . . . . >9kV
● Large differential VOUT . . . . . 2.8V into 54Ω
Better noise immunity, or drive up to 6 terminations
●High data rates. . . . . up to 40Mbps
●Specified for +125 ° C operation
●11/13ns (maximum) Tx/Rx propagation delays; 1.5ns (maximum) skew
●1/5 unit load allows up to 160 devices on the bus
● Full fail-safe (open, shorted, terminated/undriven) receiver
● High Rx IOL to drive optocouplers for isolated applications
● Hot plug - Tx and Rx outputs remain three-state during power-up
● Low quiescent supply current. 4mA
● Low current shutdown mode 1μA
●-7V to +12V common-mode input voltage range
● Three-state Rx and Tx outputs
●Operates from a single +5V supply (10% tolerance)
● Current limiting and thermal shutdown for driver overload protection
● Pb-free (RoHS compliant)



SOP8/MSOP8

Applications

● PROFIBUS DP and FMS networks
●SCSI “ fast 40 ” drivers and receivers
●Motor controller/position encoder systems
●Factory automation
●Field bus networks
●Security networks
●Building environmental control systems
●Industrial/process control networks

Description

The ISL3159E is a ±15kV IEC61000 ESD protected, 5V powered, single transceiver that meets both the RS-485 and RS-422 standards for balanced communication. It also features the larger output voltage and higher data rate (up to 40Mbps) required by high speed PROFIBUS applications, and is offered in industrial and extended Industrial (-40 ° C to +125 ° C) temperature ranges. The low bus currents (+220μA/-150μA) present a 1/5 unit load to the RS-485 bus. This allows up to 160 transceivers on the network without violating the RS-485 specification ' s load limit and without using repeaters.

This transceiver requires a 5V ±10% tolerance supply, and delivers at least a 2.1V differential output voltage over this supply range. This translates into better noise immunity (data integrity), longer reach, or the ability to drive up to six 120Ω terminations in " star " or other nonstandard bus topologies, at the exceptional 40Mbps data rate.

SCSI applications benefit from the ISL3159E ' s low receiver and transmitter part-to-part skews. The ISL3159E is perfect for high speed parallel applications requiring simultaneous capture of large numbers of bits. The low bit-to-bit skew eases the timing constraints on the data latching signal.

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 >30mA at V_{OL} = 1V) to ease the design of optically isolated interfaces.

Hot plug circuitry ensures that the Tx and Rx outputs remain in a high impedance state while the power supply stabilizes.

Driver (Tx) outputs are short-circuit protected, even for voltages exceeding the power supply voltage. Additionally, on-chip thermal shutdown circuitry disables the Tx outputs to prevent damage if power dissipation becomes excessive.

Truth Table

TRANSMITTING				
INPUTS			OUTPUTS	
RE	DE	DI	B/Z	A/Y
X	1	1	0	1
X	1	0	1	0
0	0	X	High-Z	High-Z
1	0	X	High-Z*	High-Z*

NOTE: *Shutdown mode

Truth Table

RECEIVING			
INPUTS			OUTPUT
RE	DE	A-B	RO
0	0	$V_{AB} \geq -0.05V$	1
0	0	$-0.05V > V_{AB} > -0.2V$	Undetermined
0	0	$V_{AB} \leq -0.2V$	0
0	0	Inputs Open/Shorted	1
1	1	X	High-Z
1	0	X	High-Z*

NOTE: *Shutdown mode

Pin Descriptions

PIN	FUNCTION
RO	Receiver output. If A-B≥-50mV,RO is high.If A-B≤-200mV,RO is low.If A and B are unconnected(floating)or shorted,or connected to a terminated bus that is undriven,RO is high.
RE	Receiver output enable.RO is enabled when RE is low.RO is high impedance when RE is high.If the Rx enable function isn't required,connect RE directly to GND.
DE	Driver output enable.The driver outputs,Yand Z,are enabled by bringing DE high.They are high impedance when DE is low.If the Txenable function isn't required,connect DE to V_{cc} through a 1kΩ orgreater resistor.
DI	Driver input.A low on DI forces output Y low and output Z high.Similarly,a high on DI forces output Yhigh and output Z low.
GND	Ground connection.This is also the potential of the DFN's exposed metal pad.
A/Y	±15KV IEC61000 ESD protected RS-485/422 level,noninverting receiver input and noninverting driver output.This pin is an input (A)if DE=0;pin is an output (Y)if DE=1.
B/Z	±15KV IEC61000 ESD protected RS485/422 level,inverting receiver input and inverting driver output.This pin is an input(B)if DE=0;pin is an output (Z)if DE=1.
V_{cc}	System power supply input(4.5V to 5.5V).
NC	No internal connection.
EP	The exposed metal pad on the bottom of the DFN;connect to GND.

Typical Operating Circuit

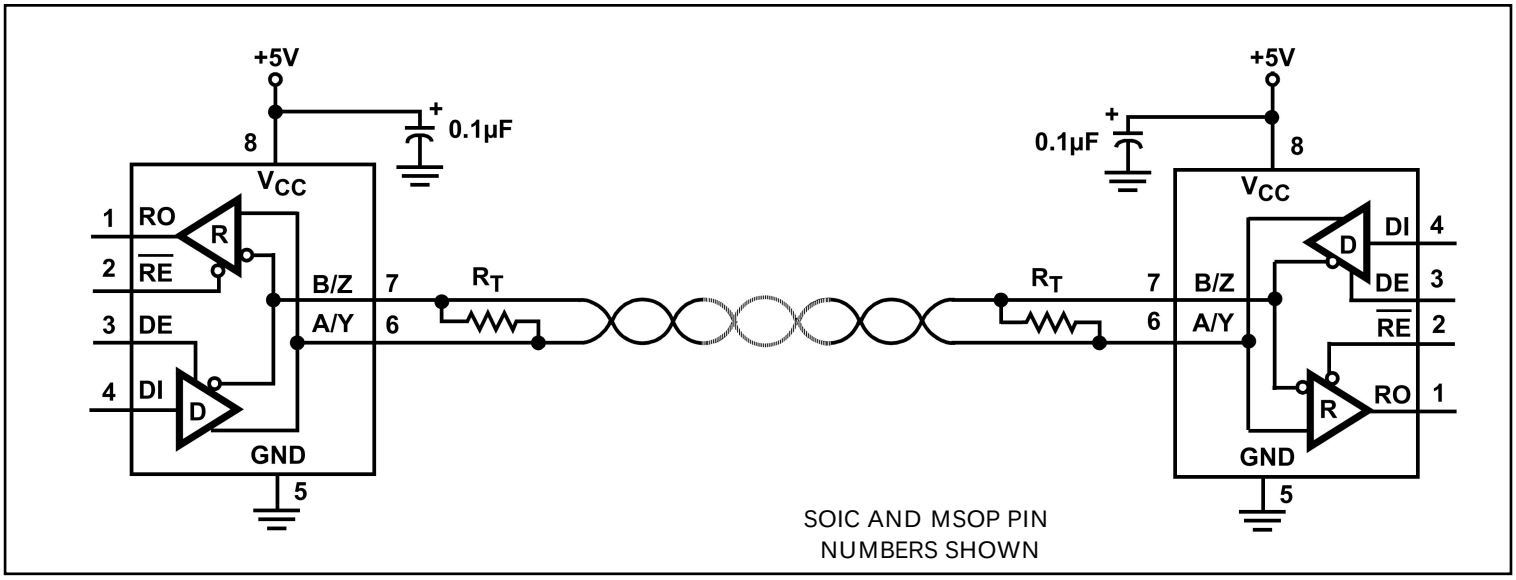


FIGURE 1. TYPICAL OPERATING CIRCUIT

Absolute Maximum Ratings

V_{CC} to GND 7V
Input Voltages
DI, DE, RE. . . . . -0.3V to 7V
Input/Output Voltages
A/Y, B/Z . . . . . -9V to +13V
RO. . . . . -0.3V to (V_{CC} +0.3V)
Short-circuit Duration
Y, Z . . . . . Continuous
ESD Rating . . . . . Refer to “ Electrical Specifications ”

Thermal Information

Thermal Resistance(Typical)	θ_{JA}(°C/W)	θ_{JC}(° C/W)
8Ld SOIC Package(Notes 1,3	105	60
8Ld MSOP Package(Notes 1,3	140	55
10 Ld DFN Package(Notes 2,4	46	3.5

Maximum Junction Temperature(Plastic Package)……+150°C
Maximum Storage Temperature Range……65°C to+150°C

NOTES:
1. θ_{JA} is measured with the component mounted on a high-effective thermal conductivity test board in free air.
2. θ_{JA} is measured in free air with the component mounted on a high-effective thermal conductivity test board with “ direct attach ” features.
3. For θ_{JC}, the “ case temp ” location is taken at the package top center.
4. For θ_{JC}, the “ case temp ” location is the center of the exposed metal pad on the package underside.

Electrical Specifications

Test Conditions: V_{CC} = 4.5V to 5.5V; unless otherwise specified. Typical values are at V_{CC} = 5V, T_A = +25°C, (Note 5)

PARAMETER	SYMBOL	TEST CONDITIONS		TEMP (℃)	MIN (Note15)	TYP	MAX (Note15)	UNIT
DC CHARACTERISTICS								
Driver Differential V_{OUT}	V_{OD}	No Load		Full	-	-	V_{CC}	
		R_L=100Ω(RS-422)(Figure 3A)		Full	2.6	3.4		V
		R_L=54Ω(RS-485) (Figure 3A)	I Suffix	Full	2.1	2.8	V_{CC}	V
			F Suffix ,(Note14)	Full	2.1	2.8	V_{CC}	V
		R_L=60Ω,-7V≤V_{CM}≤12V (Figure 3B,Note 14)		Full	1.9	2.7	-	V
Change in Magnitude of Driver Differential V_{OUT} for Complementary Output States	△V_{OD}	R_L=54Ω or 100Ω(Figure 3A)		Full	-	0.01	0.2	V
Driver Common-Mode V_{OUT}	V_{OC}	R_L=54Ω or 100Ω (Figure3A,Note 14)		Full	-	2	3	V
Change in MagnitudeofDriver Common-Mode V_{OUT} for Complementary Output States	△V_{OC}	R_L=54Ωor 100Ω (Figure3A)		Full		0.01	0.2	V
Logic Input High Voltage	V_{IH}	DI,DE,RE		Full	2	-		V
Logic Input Low Voltage	V_{IL}	DI,DE,RE		Full	-		0.8	V
Logic Input Current	I_{IN1}	DI=DE=RE=0V or V_{CC}		Full	-2	-	2	μA
Input Current (A/Y,B/Z)	I_{IN2}	DE=0V,Vcc=0V or 5.5V	V_{IN}= 12V	Full			220	μA
			V_{IN}= -7V	Full	-160			μA

Electrical Specifications(Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (℃)	MIN (Note15)	TYP	MAX (Note15)	UNIT
DC CHARACTERISTICS							
Driver Short-Circuit Current,V_O=High or Low	I_{OSD1}	DE=V_{CC}-7V≤V_Y or V_Z≤ 12V(Note 7)	Full	-	—	±250	mA
Differential Capacitance	C_D	A/Y to B/Z	25	-	9		pF
Receiver Differential Threshold Voltage	V_{TH}	-7V≤V_{CM}≤12V	Full	-200		-50	mV
Receiver Input Hysteresis	△V_{TH}	V_{CM}=0V	25	—	28		mV
Receiver Output High Voltage	V_{OH}	I_O=-8mA,V_{ID}=-50mV	Full	V_{CC}-0.5			V
Receiver Output Low Voltage	V_{OL}	I_O=+10mA,V_{ID}=-200mV	Full		-	0.4	V
Receiver Output LowCurrent	I_{OL}	V_{OL}=1V,V_{ID}=-200mV	Full	25	40	-	mA
Three-state (highimpedance) Receiver Output Current	I_{OZR}	0.4V≤V_O≤2.4V	Full	-1	0.015	1	μA
Receiver Input Resistance	R_{IN}	-7V≤V_{CM}≤12V	Full	54	80	—	kΩ
Receiver Short-Circuit Current	I_{OSR}	0V≤V_O≤V_{CC}	Full	±20	-	±110	mA
SUPPLY CURRENT							
No-LoadSupply Current(Note6)	I_{CC}	DI=DE=0V or V_{CC}	Full	-	2.6	4	mA
Shutdown Supply Current	I_{SHDN}	DE=0V,RE=V_{CC},DI=0V or V_{CC}	Full	-	0.05	1	μA

Electrical Specifications(Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (℃)	MIN (Note15)	TYP	MAX (Note15)	UNIT
ESD PERFORMANCE							
RS-485 Pins(A/Y,B/Z)		IEC61000-42,Air-Gap Discharge Method	25	-	± 15	-	kV
		IEC61000-4-2,Contact Discharge Method	25		±8	-	kV
		Human Body Model,From Bus Pinsto GND	25		±16.5	-	kV
All Pins		HBM,per MIL-STD-883 Method3015	25	—	>±9	—	kV
		Machine Model	25	-	>± 400	-	V
DRIVER SWITCHING CHARACTERISTICS							
Maximum Data Rate	f_{MAX}	V_{OD}≥±1.5V,R_D=54Ω,C_L= 100pF(Figure 6)	Full	40	-	-	Mbps
Driver Differential Output Delay	t_{DD}	R_D=54Ω,C_D=50pF(Figure 4)	Full		8	12	ns
Driver Differential Output Skew	t_{SKEW}	R_D=54Ω,C_D=50pF(Figure 4)	Full		0.5	1.5	ns
Prop Delay Part-to-Part Skew	t_{SKP-P}	R_D=54Ω,C_D=50pF(Figure 4,Note13)	Full	-	-	4	ns
DRIVER SWITCHING CHARACTERISTICS							
Driver Differential Rise orFall Time	t_R,t_F	Ro=54Ω,C_D=50pF(Figure 4)	Full	2	5	8	ns
Driver Enable to Output High	t_{ZH}	R_L=110Ω,C_L=50pF,SW= GND(Figure 5,Note 8)	Full		13	20	ns
Driver Enable to Output Low	t_{ZL}	R_L=110,C_L=50pF,SW=V_{CC} (Figure5.Note 8)	Full		11	20	ns
Driver Enable Time Skew	t_{ENSKEW}	It$_{ZH}$(Y or Z)-t$_{ZL}$(Z or Y)I	Full		2.5	-	ns
Driver Disable from Output High	t_{HZ}	R_L=110Ω,C_L=50pF,SW= GND(Figure 5)	Full	-	14	20	ns

Electrical Specifications(Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note15)	TYP	MAX (Note15)	UNIT
Driver Disable from Output Low	t_{LZ}	R_L=110,C_L=50pF,SW=V_{CC} (Figure5)	Full	-	12	20	ns
Driver Disable Time Skew	$t_{DISSKEW}$	$\|t_{HZ}$(Y or Z)-t_{ZL}(Z or Y)$\|$	Full	-	3		ns
Time to Shutdown	t_{SHDN}	(Note 10)	Full	60	-	600	ns
Driver Enablefrom Shutdownto Output High	$t_{ZH(SHDN)}$	R_L=110Ω,C_L=50pF,SW= GND(Figure 5,Notes 10, 11)	Full			1000	ns
Driver Enablefrom Shutdownto Output Low	$t_{ZL(SHDN)}$	R_L=110,C_L=50pF,SW=V_{CC} (Figure5,Notes 10,11)	Full			1000	ns
RECEIVER SWITCHING CHARACTERISTICS							
Maximum Data Rate	f_{MAX}	V_{ID}=±1.5V	Full	40	-	-	Mbps
Receiver Input to Output Delay	t_{PLH},t_{PHL}	(Figure 7)	Full	—	9	13	ns
Receiver Skew $\|t_{PLH}$-$t_{PHL}\|$	t_{SKD}	(Figure 7)	Full	-	0	1.5	ns
Prop Delay Part-to-Part Skew	t_{SKP-P}	(Figure 7,Note 13)	Full		-	4	ns
Receiver Enable to Output High	t_{ZH}	R_L=1kΩ,C_L=15pF,SW= GND(Figure 8,Note 9)	Full	-	-	12	ns
Receiver Enable to Output Low	t_{ZL}	R_L=1kΩ,C_L=15pF,SW=V_{CC} (Figure 8,Note 9)	Full	-	-	12	ns
Receiver Disable from Output High	t_{HZ}	R_L=1kΩ,C_L=15pF,SW= GND(Figure 8)	Full			12	ns
Receiver Disable from Output Low	t_{LZ}	R_L=1kΩ,C_L=15pF,SW=V_{CC} (Figure 8)	Full	-	-	12	ns
Time to Shutdown	t_{SHDN}	(Note 10)	Full	60	-	600	ns

Electrical Specifications(Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note15)	TYP	MAX (Note15)	UNIT
Receiver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	R_L=1kΩ,C_L=15pF,SW= GND(Figure 8,Notes10,12)	Full	-	-	1000	ns
Receiver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	R_L=1kΩ,C_L=15pF,SW=V_{CC} (Figure 8.Notes 10,12)	Full	-		1000	ns

NOTES:

5. All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to device ground unless otherwise specified.
6. Supply current specification is valid for loaded drivers when DE = 0V.
7. Applies to peak current.
8. Because of the shutdown feature, keep RE = 0 to prevent the device from entering SHDN.
9. Because of the shutdown feature, the RE signal high time must be short enough (typically <100ns) to prevent the device from entering SHDN.
10. These ICs are put into shutdown by bringing RE high and DE low. If the inputs are in this state for less than 60ns, the parts are guaranteed not to enter shutdown. If the inputs are in this state for at least 700ns, the parts are guaranteed to have entered shutdown.
11. Keep RE = V_{CC}, and set the DE signal low time >700ns to ensure that the device enters SHDN.
12. Set the RE signal high time >700ns to ensure that the device enters SHDN.
13. This is the part-to-part skew between any two units tested with identical test conditions (temperature, V_{CC}, etc.).
14. V_{CC} = 5V ±5%
15. Parts are 100% tested at +25 ° C. Over-temperature limits established by characterization and are not production tested

Test Circuits and Waveforms

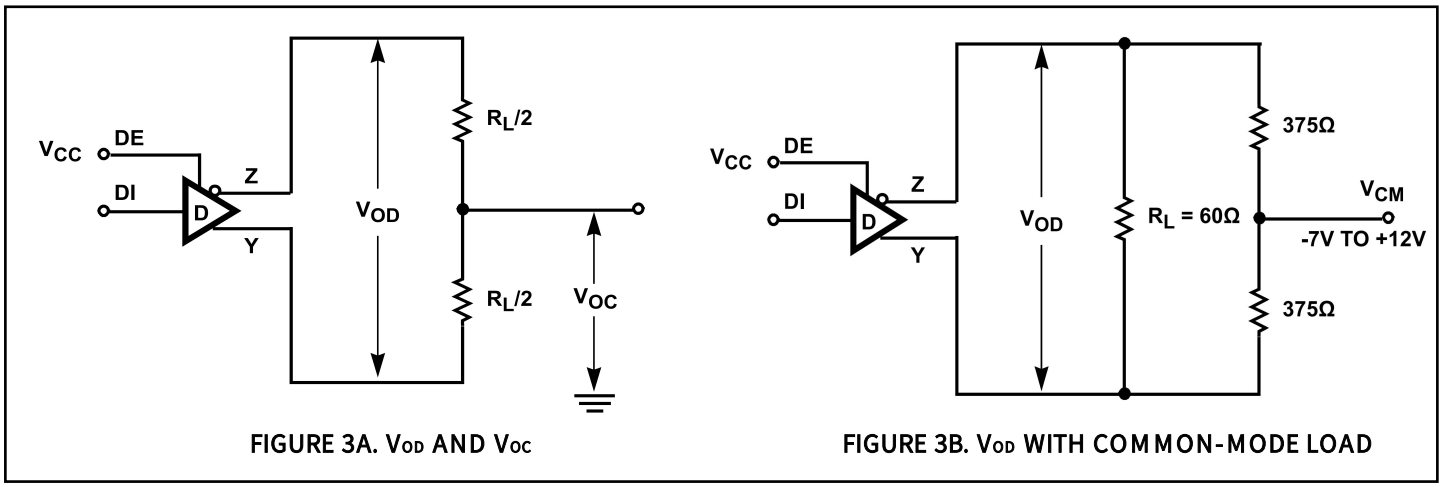


FIGURE 3A. V_{OD} AND V_{OC}

FIGURE 3B. V_{OD} WITH COMMON-MODE LOAD

FIGURE 3. DC DRIVER TEST CIRCUITS

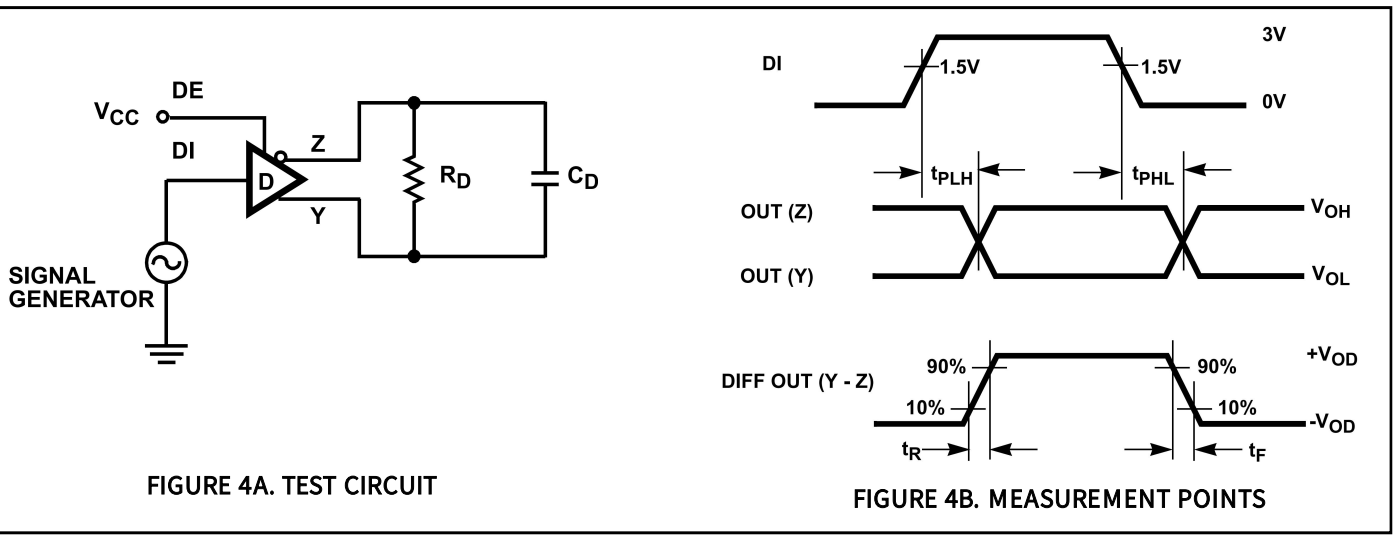
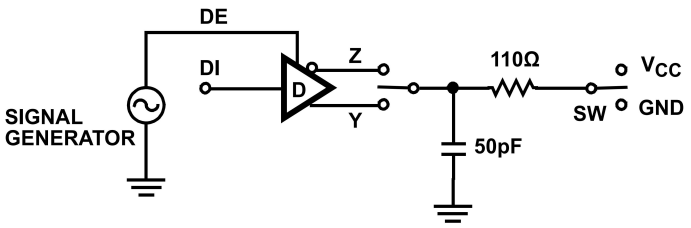


FIGURE 4A. TEST CIRCUIT

FIGURE 4B. MEASUREMENT POINTS

FIGURE 4. DRIVER PROPAGATION DELAY AND DIFFERENTIAL TRANSITION TIMES



PARAMETER	OUTPUT	RE	DI	SW
t_{HZ}	Y/Z	X	1/0	GND
t_{LZ}	Y/Z	X	0/1	V_{CC}
t_{ZH}	Y/Z	0(Note 12)	1/0	GND
t_{ZL}	Y/Z	0(Note 12)	0/1	V_{CC}
$t_{HZ(SHDN)}$	Y/Z	1(Note 15)	1/0	GND
$t_{LZ(SHDN)}$	Y/Z	1(Note 15)	0/1	V_{CC}

FIGURE 8A. TEST CIRCUIT

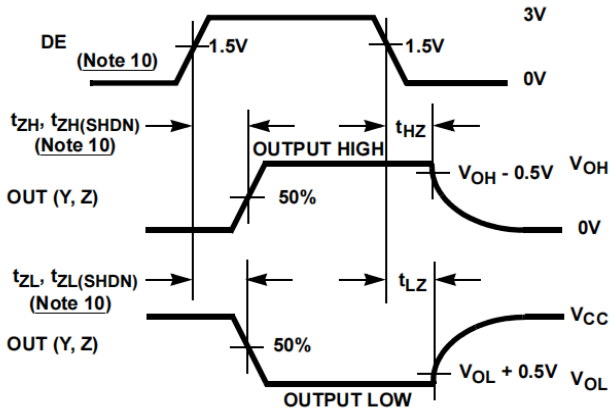


FIGURE 5B. MEASUREMENT POINTS

FIGURE 5. DRIVER ENABLE AND DISABLE TIMES

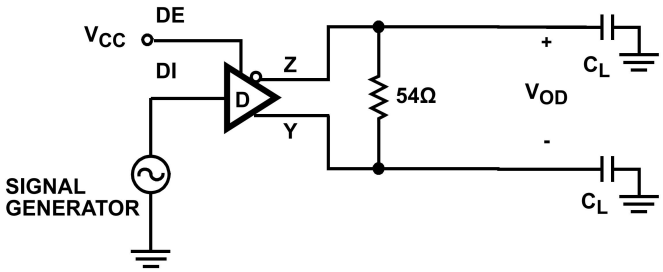


FIGURE 6A. TEST CIRCUIT

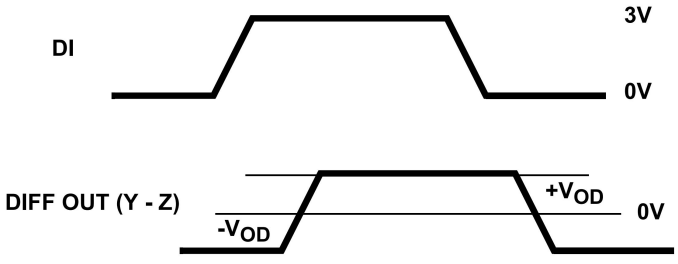


FIGURE 6B. MEASUREMENT POINTS

FIGURE 6. DRIVER DATA RATE

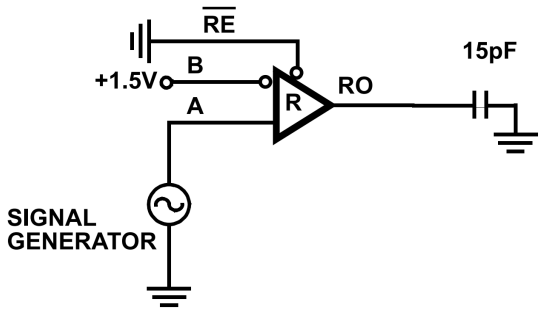


FIGURE 7A. TEST CIRCUIT

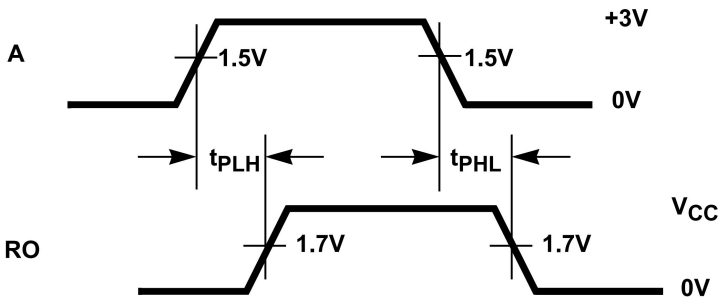
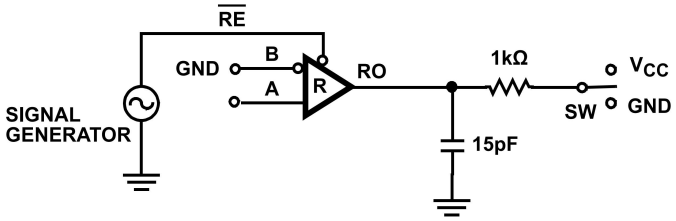


FIGURE 7B. MEASUREMENT POINTS

FIGURE 7. RECEIVER PROPAGATION DELAY



PARAMETER	DE	A	SW
t_{HZ}	0	+1.5V	GND
t_{LZ}	0	-1.5V	V_{CC}
t_{ZH}(Note 13)	0	+1.5V	GND
t_{ZL}(Note 13)	0	-1.5V	V_{CC}
$t_{HZ(SHDN)}$(Note 16)	0	+1.5V	GND
$t_{LZ(SHDN)}$(Note 16)	0	-1.5V	V_{CC}

FIGURE 8A. TEST CIRCUIT

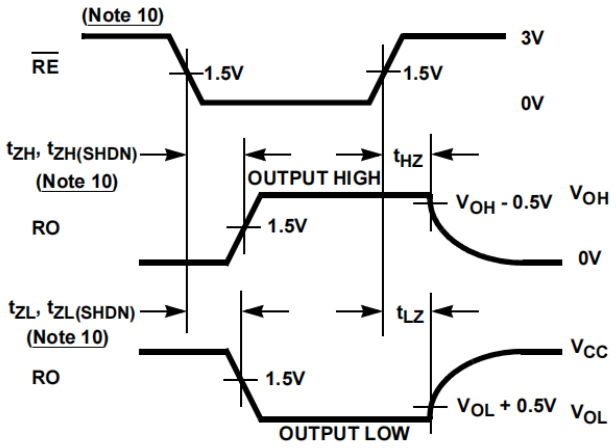


FIGURE 8B. MEASUREMENT POINTS

FIGURE 8. RECEIVER ENABLE AND DISABLE TIMES

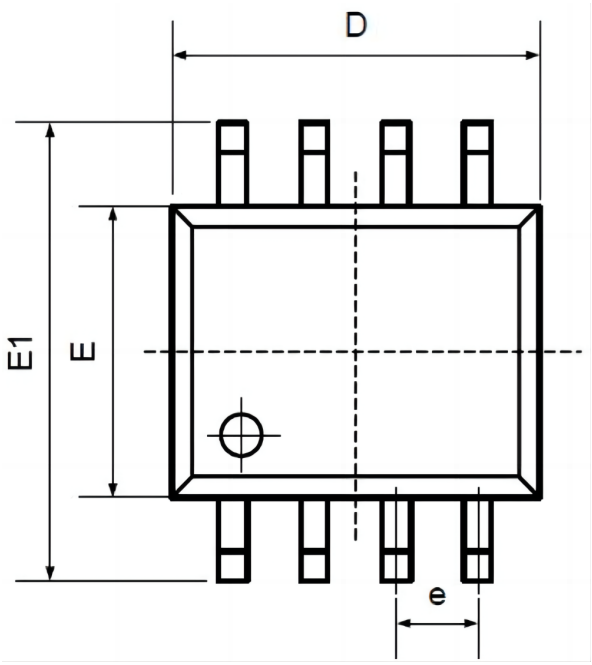
ORDERING INFORMATION

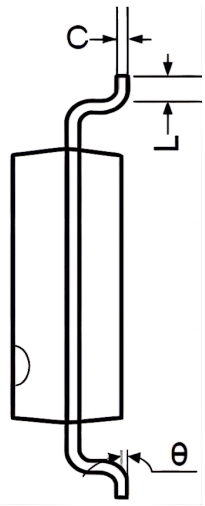
Order Number	Package	Package Quantity	Marking On The park	Temperature
ISL3159EIBZ-T-TUDI	SOP8	Tape,Reel,2500	3159EIBZ	-40℃ to +85℃
ISL3159EIUZ-T-TUDI	MSOP8	Tape,Reel,2500	3159Z	
ISL3159EFBZ-T-TUDI	SOP8	Tape,Reel,2500	3159EFBZ	-40℃ to +125℃
ISL3159EFUZ-T-TUDI	MSOP8	Tape,Reel,2500	159FZ	

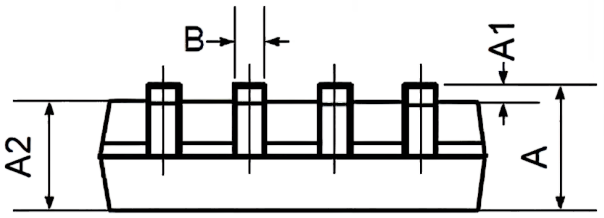
Revision history

	Date	Revision	Page
V1.0	2020/1	New	1-10
V1.1	2025-4	Update model and PDF template	1-19

Package SOP8

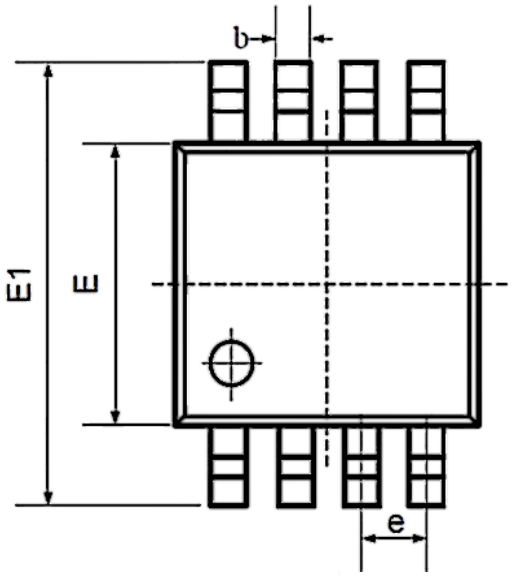


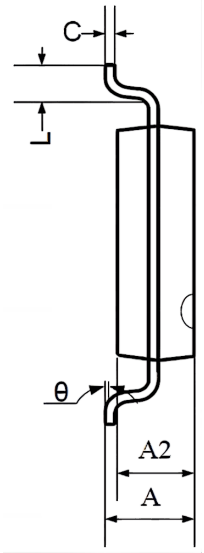


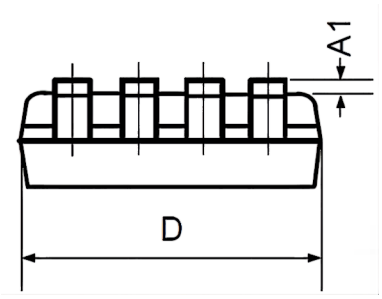


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP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

Package MSOP8







Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.200	0.031	0.047
A1	0.000	0.200	0.000	0.008
A2	0.760	0.970	0.030	0.038
b	0.30 TYP		0.012 TYP	
C	0.15 TYP		0.006 TYP	
D	2.900	3.100	0.114	0.122
e	0.65 TYP		0.026 TYP	
E	2.900	3.100	0.114	0.122
E1	4.700	5.100	0.185	0.201
L	0.410	0.650	0.016	0.026
θ	0°	6°	0°	6°

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