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Tudi Semiconductor

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## Product Specification

### TUDI-MAX3491E

3.3V-Powered,  $\pm 15kV$  ESD-Protected, 12Mbps and Slew-Rate-Limited True RS-485/RS-422 Transceivers

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## Features

- ESD protection for RS-485 I/O pins  
±15kV—Human Body Model  
±8kV—IEC 1000-4-2, Contact discharge  
±15kV—IEC 1000-4-2, Air gap discharge
- 3.3V power supply
- Compatible with 5V logic
- 12Mbps data rate
- Low current shutdown mode
- -7V to 12V common mode input voltage range
- Current limiting and thermal shutdown for driver over-load protection

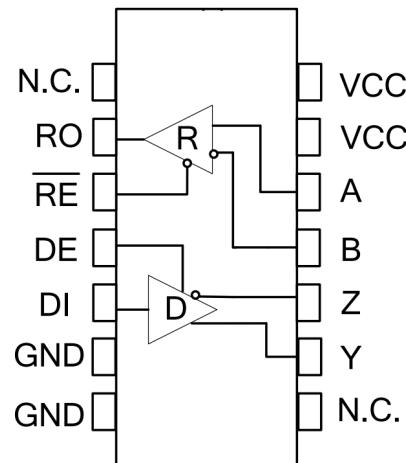


Figure 1 3491E Pin diagram

## Description

The MAX3491E is a low-power, 3.3V transceiver for RS-485 and RS-422 communication with ±15kV ESD protection. Each device contains a driver and a receiver. The MAX3491E has a data rate up to 1Mbps. The devices feature enhanced electrostatic discharge (ESD) protection. All drivers and receiver inputs are protected by IEC 1000-4-2 air gap (±15kV), IEC 1000-4-2 contact discharge (±8kV), and human body model (±15kV). The driver features short-circuit current limiting and is protected by a thermal shutdown circuit that places the driver output into a high-impedance state. The receiver input has a fail-safe function that guarantees a logic high output if both inputs are open. The MAX3491E features full-duplex communication.

## Applications

- Telecommunications
- Industrial-Control Local Area Networks
- Transceivers for EMI-Sensitive Applications
- Integrated Services Digital Networks
- Packet Switching



## Pin description

Pin number	Pin name	Pin function
1	NC	No internal connection, no need to connect;
2	RO	Receiver output. When /RE is low, if $A-B \geq -10mV$ , RO output is high; if $A-B \leq -200mV$ , RO output is low.
3	/RE	Receiver output enable control. When /RE is low, the receiver output is enabled and RO is valid; when /RE is high, the receiver is disabled and RO is high impedance; /RE is high and DE is low, the device enters low-power off mode.
4	DE	Driver output enable control. The driver output is active when DE is high, and the output is high-impedance when DE is low; / is high and DE is low, the device enters low-power shutdown mode.
5	DI	DI driver input. A low on DI with DE high causes the driver's A output to be low and B output to be high; a high DI will cause the A output to be high and the B output to be low.
6	GND	grounding
7	GND	grounding
8	NC	No internal connection, no need to connect;
9	Y	Drivers in-phase output
10	Z	Inverting output of the driver
11	B	Inverting input of the receiver
12	A	Receiver in-phase input terminal
13	VCC	This pin can be connected to the power supply ( $3V \leq VCC \leq 5.5V$ ) or can be left unconnected
14	VCC	Power supply: $3V \leq VCC \leq 5.5V$

## Extreme parameter

Parameter	Symbol	Unit	size
Continuous power consumption	SOP14	mW	600
	DIP14	mW	700
Power supply voltage	VCC	V	+7
working temperature range		°C	-40~125
Storage temperature range		°C	-60~150
Welding temperature range		°C	300
Control port voltage	DI	V	-0.3~VCC+0.3
Bus side input voltage	A、B	V	-8~13
Receiver output voltage	RO	V	-0.3~VCC+0.3

The maximum limit parameters are values beyond which the device can be damaged in an irreversible manner. Operation of the device under these conditions is not intended to be normal and may affect the reliability of the device if operated continuously at the maximum rated limit. All voltages are referenced to ground.



Parameter	Symbol	Test condition	Minimum	Typical case	Maximum	Unit
Supply current						
Supply current	Icc1	/RE=0V,DE=0V		220	400	uA
	Icc2	/RE=VCC,DE=		240	400	uA
Turn off the current	ISHDN	RE=VCC,DE=0V		0.5	10	uA
ESD protect						
A, B, Y, Z		Human body model(HBM)		±15		KV
Other ports		Human body model(HBM)		±6		KV
The DC electrical characteristics of the receiver						
Input current (A,B)	IN2	VCC=0 or 3.3 V VIN=12 V			125	uA
		VCC=0 or 3.3 V VIN = -7V	-100			uA
Forward input threshold voltage	VIT+	-7V≤VCM≤12 V			-10	mV
Reverse input threshold voltage	VIT-	-7V≤VCM≤12 V	-200			mV
Input the hysteresis voltage	Vhys	-7V≤VCM≤12 V	10	30		mV
High level output voltage	VoH	IoUT=-4mA, VID =+200 mV	VCC-1.5			V
Low-level output voltage	VoL	IoUT=+4mA, VID=-200 mV			0.4	V
Three-state input leakage current	IoZR	0.4V<Vo<2.4V			±1	uA
Receiver input resistance	RN	-7V≤VCM≤12 V	96			kΩ
Receiver short-circuit current	IosR	0V≤Vo≤VCC	±7		±95	mA

(If not otherwise, VCC=3V~5.5V, Temp = TMIN ~ TMAX, typical value at Temp = 25 ) NOTE 1: VO D and? VOC is the change in VOD and VOC amplitude caused when the DI state of the input signal changes, respectively.



Parameter	Symbol	Test condition	Minimum	Typical case	Maximum	Unit
The DC electrical characteristics of the drive device						
Drive differential output(no load)	VoD?		3		5.5	V
Drive differential output	VoD2	Graph 2,RL=27 Ω	1.5		VCC	V
		Graph 2,RL=50 Ω	2		VCC	
Changes in the output voltage amplitude (NOTE1)	△VoD	Graph 2,RL=27 Ω			0.2	V
Output common mode voltage	Voc	Graph 2,RL=27 Ω			3	V
Change in common mode output voltage amplitude(NOTE 1)	△Voc	Graph 2,RL=27 Ω			0.2	V
High-level input	VH	DI	2.0			V
Low level input	Vπ	DI			0.8	V
Logical input cur-rent	IN?	DI	-2		2	uA
Output short circuit current, short circuit to high	IosD?	Short-circuit to OV~12V	35		250	mA
Output short circuit current, short circuit to low	IosD2	Short-circuit to -7V~OV	-250		-35	mA
Drive switch characteristics						
Drive input to output propagation delay(low to high)	tDPLH	RDIFF=54Ω, CLi= CL?=100 pF (see Figure 3 and Figure 4)		15	35	ns
Drive input to output propagation delay(high to low)	tDPHL			15	35	ns
tDPLH-tDPHL	tsKEW1			7	10	ns
Up along time / down along time	tDR,tDF			10	25	ns
Amission to output high	tpZH	RL =1109,(see Figure 5,6)		20	90	ns
The enabling to output is low	tpZL			20	90	ns
Input low to no energy	tPLz	RL =110 Ω, (see Figure		20	80	ns
Input high to no energy	tPHZ			20	80	ns
Under off conditions,the output is high	tDSH	RL =1109,(see Figure 5,6)		500	900	ns
Under off conditions,enabling output low	tDSL	RL=1109,(see Figure 5,6)		500	900	ns



Parameter	Symbol	Test condition	Minimum	Typical case	Maximum	Unit
Receiver Switch characteristics						
Ento output high time	tRPZH	C=15 pF is shown in Figure		20	50	ns
From low output to energy-forbidden time	tpRLZ	For CL =15 pF, see Figure 7		20	45	ns
From high output to energy forbidden time	tPRHZ	For CL =15 pF, see Figure 7		20	45	ns
Enables high output time in the off state	tRPSH	For CL =15 pF, see Figure 7		200	1400	ns
Ento output low time in off state	tRPSL	For CL =15 pF, see Figure 7		200	1400	ns
Time in the off state	tsHDN	NOTE2	80		300	ns
Acceptor	tRPLH	See Figure 7 and Figure 8	20	60	90	ns
Input to output propagation latency is from low to high		VID 2.0V;rise and fall along time VID 15ns				
The receiver input to output propagation latency is obtained from high to low	tRPHL		20	60	90	ns
tRPLH-tRPHL	tsKEW2			7	10	ns
Ability to reach the output for a low time	tRPZL	For CL =15 pF, see Figure 7		20	50	ns

## Additional description

### Introduction

The 3491E is a full-duplex high-speed transceiver for RS-485/RS-42 communication, containing a driver and a receiver. It has fail-safe, overvoltage protection, and overcurrent protection. The 3491E achieves error-free transmission up to 12Mbps.

### fail-safe

The 3491E guarantees a logic high receiver output if the receiver input is short-circuited or open-circuited, or drivers connected to the terminated transmission line are disabled (idle). This is achieved by setting the receiver input thresholds to -10mV and -20mV, respectively. RO is logic high if the differential receiver input voltage  $(A-B) \geq -10mV$ , and RO is logic low if the voltage  $(A-B) \leq -200mV$ . Logic high with a minimum noise margin of 50mV can be realized depending on the receiver thresholds. The -10mV to -200mV threshold voltage is in accordance with the EIA/TIA-485 of  $\pm 200mV$ .

### 32 transceivers on the bus

The input impedance of the standard RS485 receiver is 12k (1 unit load), and the standard driver can drive to 32 unit loads. The receiver of the 3491E transceiver has an input impedance of 1/8 unit load (96k), allowing up to 32 transceivers to be connected in parallel on the same communication bus. These devices can be combined arbitrarily, or combined with other 485 transceivers, as long as the total load does not exceed 256 unit loads, they can be connected to the same bus.

### Drive output protection

Protection against excessive output current and dissipation by fault or bus contention is provided by overcurrent and overvoltage protection mechanisms, with fast short-circuit throughout the common-mode voltage range (see Typical Operating Characteristics).



## Test circuit

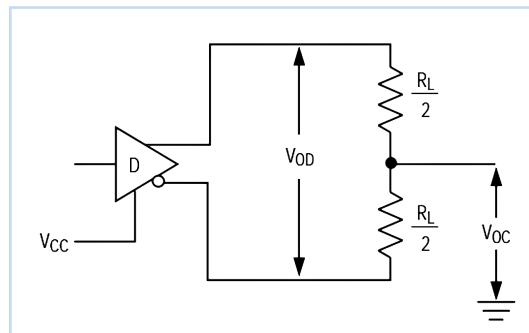


Figure 2: DC test load for the drive

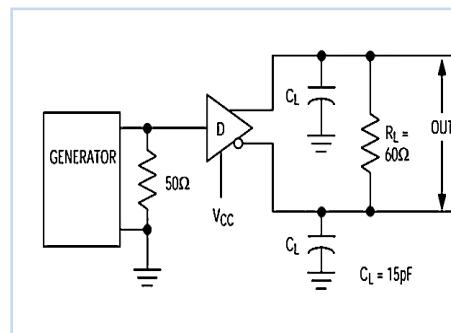


Figure 3 Drive-line Differential Delay and Transit Time

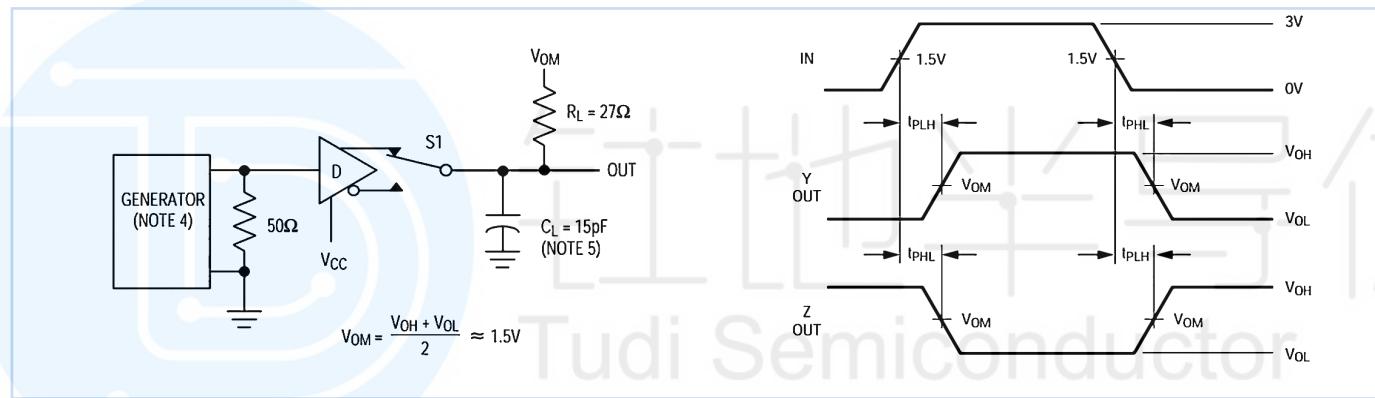


Figure 4 Drive propagation delay

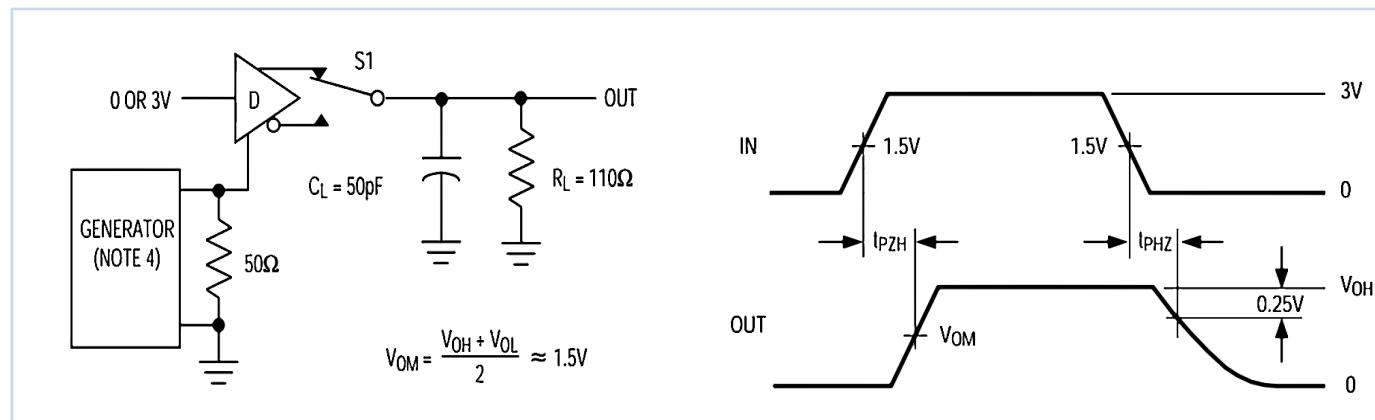


Figure 5 Drive enable and disable time

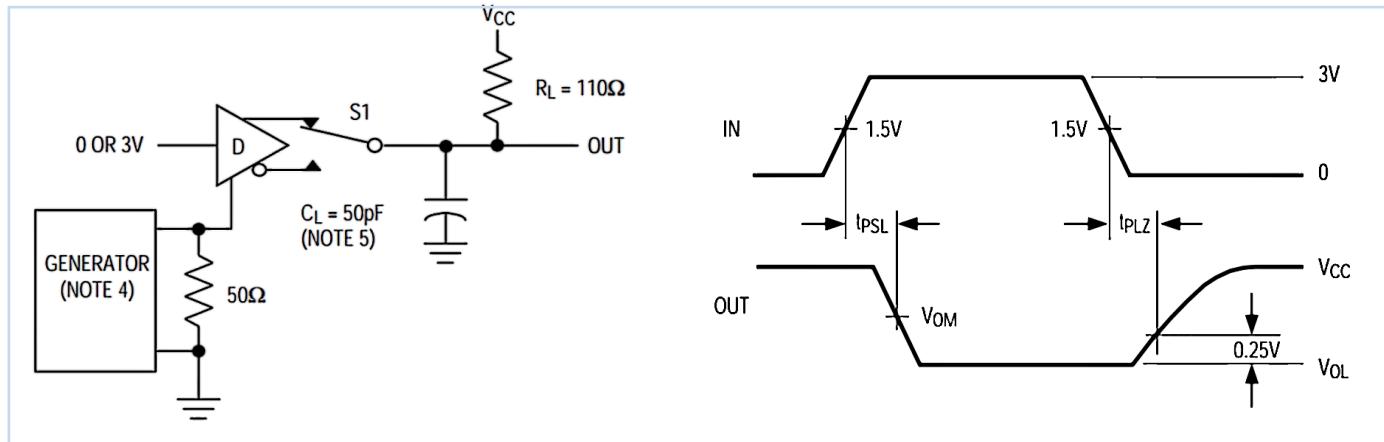


Figure 6 Drive enable and disable time

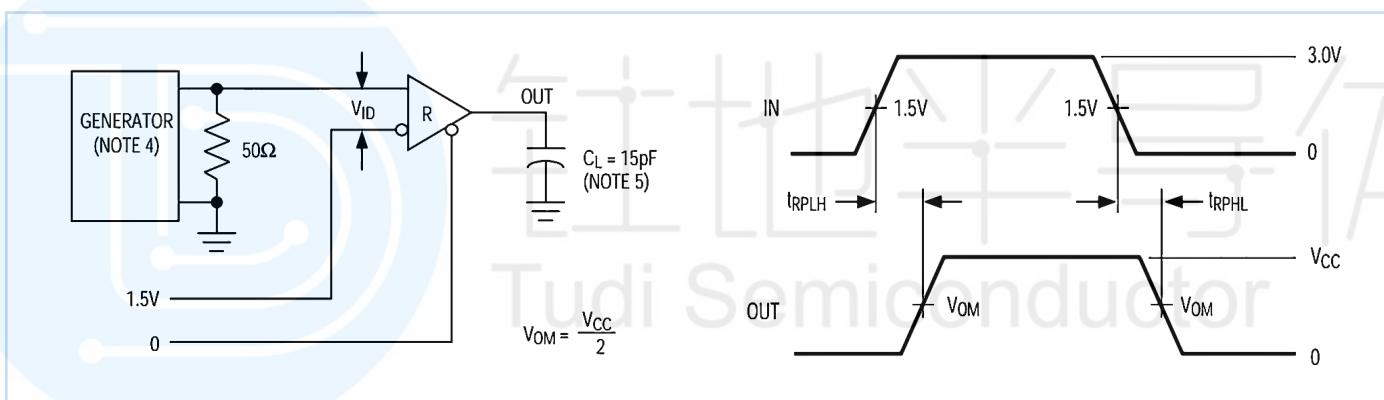
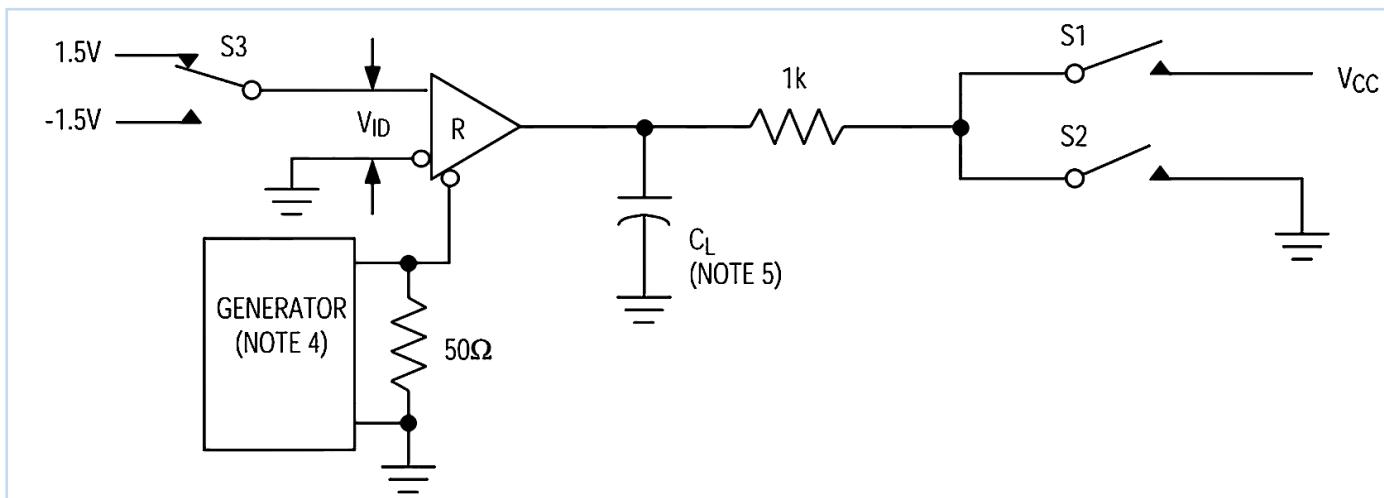


Figure 7: Receiver Propagation Delay Test Circuit



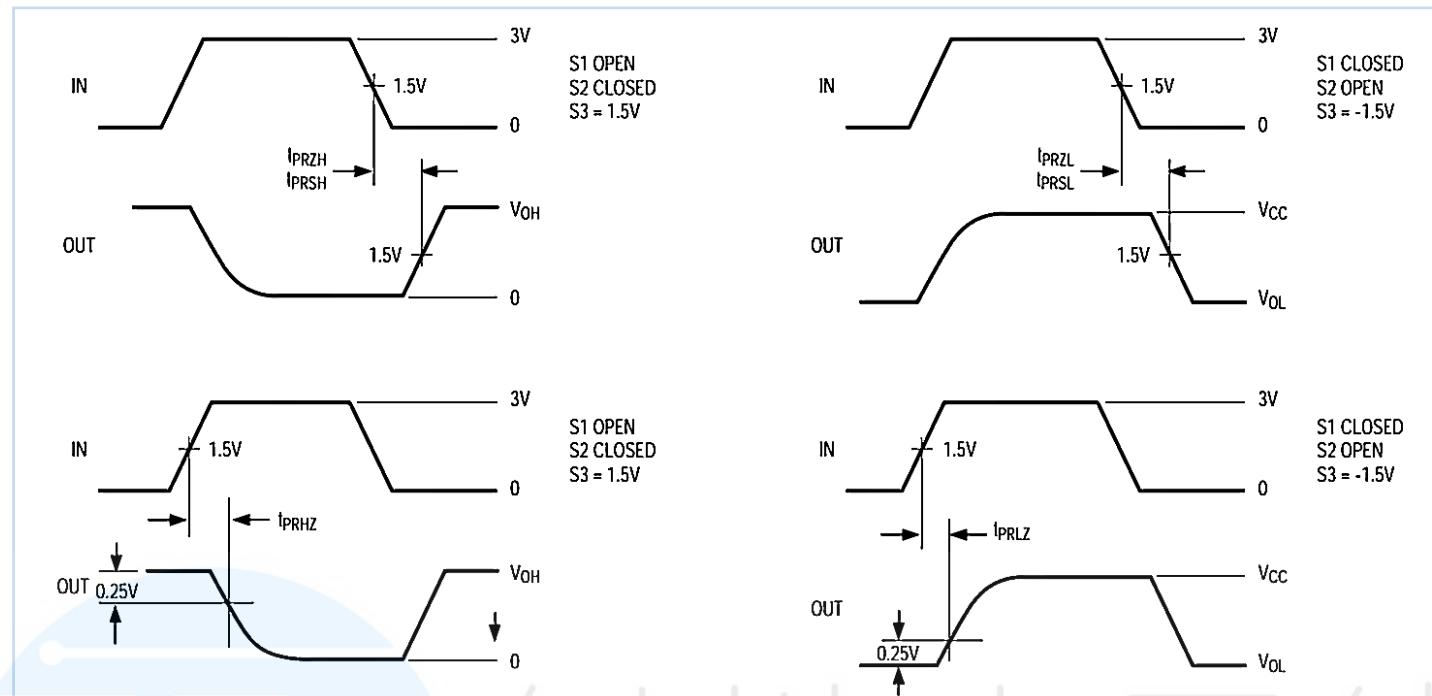


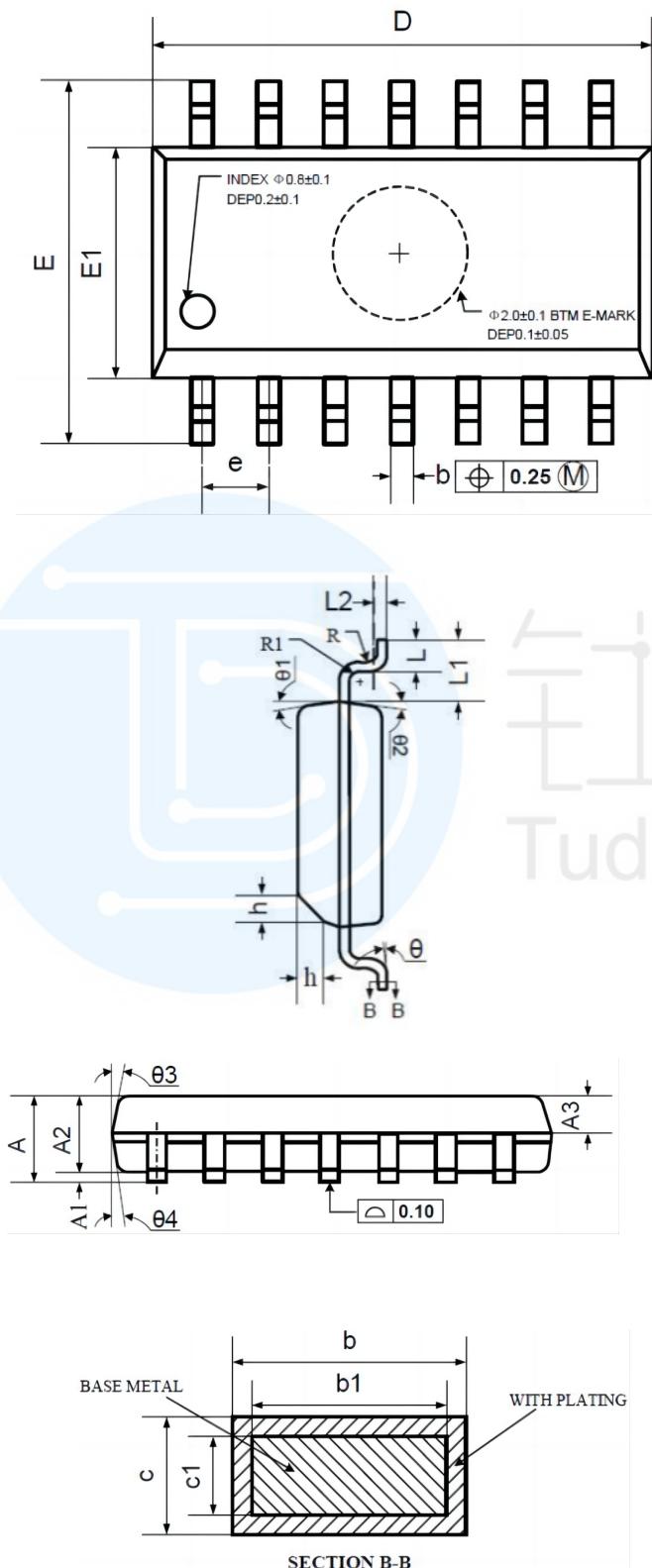
Figure 8 Receive enable and disable time

## Order information

Order Number	Package	Package Quantity	Marking On The park	Temperature
MAX3491ECSD-TUDI	SOP14	Tape,Reel,2500	MAX3491ECSD	0°C to 70°C
MAX3491ECPD-TUDI	DIP14	Tube,25,A box of 1000	MAX3491ECPD	
MAX3491EESD-TUDI	SOP14	Tape,Reel,2500	MAX3491EESD	- 40°C to 85°C
MAX3491EEPД-TUDI	DIP14	Tube,25,A box of 1000	MAX3491EEPД	



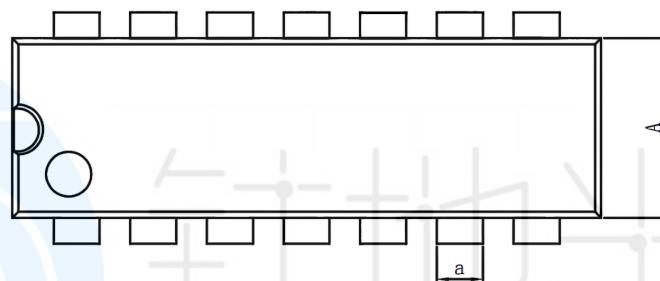
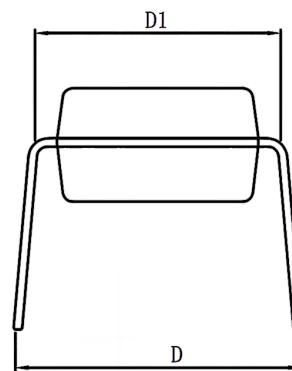
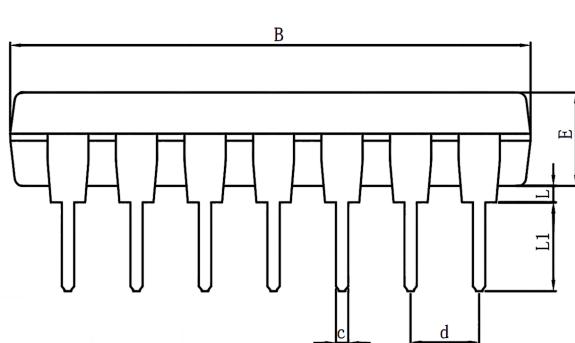
## Package SOP14



Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36		0.49
b1	0.35	0.40	0.45
C	0.16		0.25
c1	0.15	0.20	0.25
D	8.53	8.63	8.73
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e		1.27 BSC	
L	0.45	0.60	0.80
L1		1.04 REF	
L2		0.25 BSC	
R	0.07		
R1	0.07		
h	0.30	0.40	0.50
$\theta$	$0^\circ$		$8^\circ$
$\theta 1$	$6^\circ$	$8^\circ$	$10^\circ$
$\theta 2$	$6^\circ$	$8^\circ$	$10^\circ$
$\theta 3$	$5^\circ$	$7^\circ$	$9^\circ$
$\theta 4$	$5^\circ$	$7^\circ$	$9^\circ$



## Package DIP14



DIM.	MIN	TYP	MAX	DIM.	MIN	TYP	MAX
A	6.100	6.300	6.680	a	1.504	1.524	1.544
B	18.940	19.200	19.560	C	0.437	0.457	0.477
D	8.200	8.700	9.200	d	2.530	2.540	2.550
D1	7.42	7.62	7.82	L	0.500	—	0.800
E	3.100	3.300	3.550	L1	3.000	3.200	3.600



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