

芯伯乐®  
X I N B O L E

# Product Specification

XBLW SN74LS14

Hex Inverting Schmitt Trigger

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## Description

The SN74LS14 is a hex inverter with Schmitt-trigger inputs. This device features reduced input threshold levels to allow interfacing to TTL logic levels. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ . Schmitt trigger inputs transform slowly changing input signals into sharply defined jitter-free output signals.

## Features

- CMOS Input levels
- Buffered inputs
- Wide operating voltage range: 2 V to 6 V
- Low-power dissipation
- Specified from -20°C to +85°C
- Packaging information: DIP14/SOP14/TSSOP14

## Applications

- Synchronize inverted clock inputs
- Debounce a switch
- Invert a digital signal



## Ordering Information

Product Model	Package Type	Marking	Packing	Packing Qty
XBLW SN74LS14N	DIP-14	74LS14N	Tube	1000Pcs/Box
XBLW SN74LS14DTR	SOP-14	74LS14	Tape	2500Pcs/Reel
XBLW SN74LS14TDTR	TSSOP-14	74LS14	Tape	3000Pcs/Reel

### Block Diagram

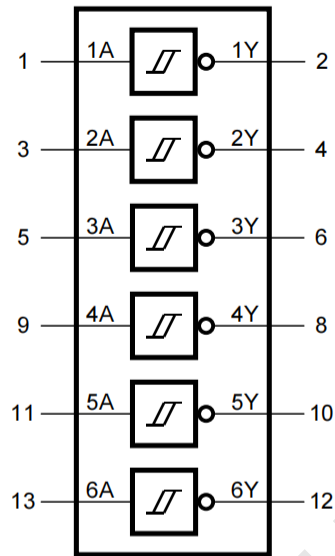


Figure 1. Logic symbol

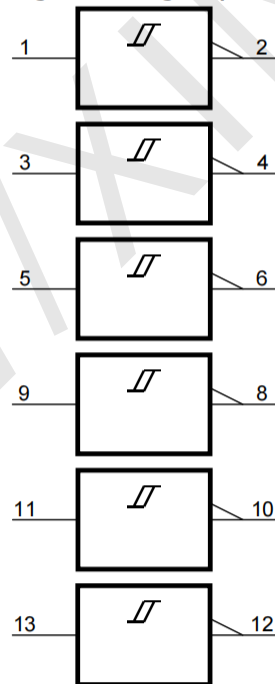
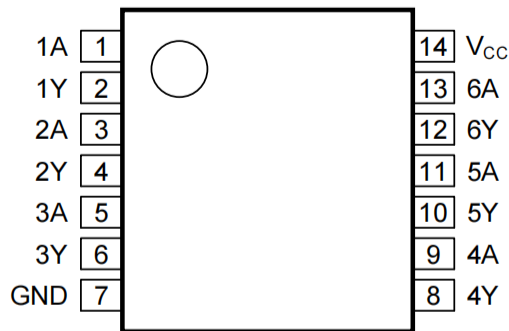


Figure 2. IEC logic symbol



Figure 3. Logic diagram for one gate

## Pin Configurations



## Pin Description

Pin No.	Pin Name	Description
1	1A	data input
2	1Y	data output
3	2A	data input
4	2Y	data output
5	3A	data input
6	3Y	data output
7	GND	ground (0V)
8	4Y	data output
9	4A	data input
10	5Y	data output
11	5A	data input
12	6Y	data output
13	6A	data input
14	V <sub>CC</sub>	supply voltage

## Function Table

Input	Output
nA	nY
L	H
H	L

Note: H=HIGH voltage level; L=LOW voltage level.

## Electrical Parameter

### Absolute Maximum Ratings

(Voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Max.	Unit
supply voltage	$V_{CC}$	-	-0.5	+7	V
input clamping current	$I_{IK}$	$V_I < -0.5V$ or $V_I > V_{CC}+0.5V$	-	$\pm 20$	mA
output clamping current	$I_{OK}$	$V_O < -0.5V$ or $V_O > V_{CC}+0.5V$	-	$\pm 20$	mA
output current	$I_O$	$-0.5V < V_O < V_{CC}+0.5V$	-	$\pm 25$	mA
supply current	$I_{CC}$	-	-	50	mA
ground current	$I_{GND}$	-	-50	-	mA
total power dissipation	$P_{tot}$	-	-	500	mW
storage temperature	$T_{stg}$	-	-65	+150	°C
soldering temperature	$T_L$	10s	DIP		°C
			SOP/TSSOP		

### Recommended Operating Conditions

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
supply voltage	$V_{CC}$	-	2.0	5.0	6.0	V
input voltage	$V_I$	-	0	-	$V_{CC}$	V
output voltage	$V_O$	-	0	-	$V_{CC}$	V
ambient temperature	$T_{amb}$	-	-20	-	+85	°C

## Electrical Characteristics

### DC Characteristics 1

( $T_{amb}=25^{\circ}\text{C}$ , voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
HIGH-level output voltage	$V_{OH}$	$V_I=V_{T+}$ or $V_{T-}$	$I_O=-20\mu\text{A}; V_{CC}=2.0\text{V}$	1.9	2.0	-	V
			$I_O=-20\mu\text{A}; V_{CC}=4.5\text{V}$	4.4	4.5	-	V
			$I_O=-20\mu\text{A}; V_{CC}=6.0\text{V}$	5.9	6.0	-	V
			$I_O=-4.0\text{mA}; V_{CC}=4.5\text{V}$	3.98	4.32	-	V
			$I_O=-5.2\text{mA}; V_{CC}=6.0\text{V}$	5.48	5.81	-	V
LOW-level output voltage	$V_{OL}$	$V_I=V_{T+}$ or $V_{T-}$	$I_O=20\mu\text{A}; V_{CC}=2.0\text{V}$	-	0	0.1	V
			$I_O=20\mu\text{A}; V_{CC}=4.5\text{V}$	-	0	0.1	V
			$I_O=20\mu\text{A}; V_{CC}=6.0\text{V}$	-	0	0.1	V
			$I_O=4.0\text{mA}; V_{CC}=4.5\text{V}$	-	0.15	0.26	V
			$I_O=5.2\text{mA}; V_{CC}=6.0\text{V}$	-	0.16	0.26	V
input leakage current	$I_I$	$V_I=V_{CC}$ or GND; $V_{CC}=6.0\text{V}$	-	-	$\pm 1$	$\mu\text{A}$	
supply current	$I_{CC}$	$V_I=V_{CC}$ or GND; $I_O=0\text{A}; V_{CC}=6.0\text{V}$	-	-	2.0	$\mu\text{A}$	
input capacitance	$C_I$	-	-	3.5	-	pF	

### DC Characteristics 2

( $T_{amb}=-20^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
HIGH-level output voltage	$V_{OH}$	$V_I=V_{T+}$ or $V_{T-}$	$I_O=-20\mu\text{A}; V_{CC}=2.0\text{V}$	1.9	-	-	V
			$I_O=-20\mu\text{A}; V_{CC}=4.5\text{V}$	4.4	-	-	V
			$I_O=-20\mu\text{A}; V_{CC}=6.0\text{V}$	5.9	-	-	V
			$I_O=-4.0\text{mA}; V_{CC}=4.5\text{V}$	3.84	-	-	V
			$I_O=-5.2\text{mA}; V_{CC}=6.0\text{V}$	5.34	-	-	V
LOW-level output voltage	$V_{OL}$	$V_I=V_{T+}$ or $V_{T-}$	$I_O=20\mu\text{A}; V_{CC}=2.0\text{V}$	-	-	0.1	V
			$I_O=20\mu\text{A}; V_{CC}=4.5\text{V}$	-	-	0.1	V
			$I_O=20\mu\text{A}; V_{CC}=6.0\text{V}$	-	-	0.1	V
			$I_O=4.0\text{mA}; V_{CC}=4.5\text{V}$	-	-	0.33	V
			$I_O=5.2\text{mA}; V_{CC}=6.0\text{V}$	-	-	0.33	V
input leakage current	$I_I$	$V_I=V_{CC}$ or GND; $V_{CC}=6.0\text{V}$	-	-	$\pm 1$	$\mu\text{A}$	
supply current	$I_{CC}$	$V_I=V_{CC}$ or GND; $I_O=0\text{A}; V_{CC}=6.0\text{V}$	-	-	20	$\mu\text{A}$	

**AC Characteristics 1**

( $T_{amb}=25^{\circ}\text{C}$ , voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
nA,nB to nY propagation delay	$t_{PLH}, t_{PHL}$	see Figure 5	$V_{CC}=2.0\text{V}$	-	41	125	ns
			$V_{CC}=4.5\text{V}$	-	15	25	ns
			$V_{CC}=5.0\text{V}; C_L=15\text{pF}$	-	12	-	ns
			$V_{CC}=6.0\text{V}$	-	12	21	ns
transition time	$t_{THL}, t_{TLH}$	see Figure 5	$V_{CC}=2.0\text{V}$	-	19	75	ns
			$V_{CC}=4.5\text{V}$	-	7	15	ns
			$V_{CC}=6.0\text{V}$	-	6	13	ns

**AC Characteristics 2**

( $T_{amb}=-20^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
nA,nB to nY propagation delay	$t_{PLH}, t_{PHL}$	see Figure 5	$V_{CC}=2.0\text{V}$	-	-	155	ns
			$V_{CC}=4.5\text{V}$	-	-	31	ns
			$V_{CC}=6.0\text{V}$	-	-	26	ns
transition time	$t_{THL}, t_{TLH}$	see Figure 5	$V_{CC}=2.0\text{V}$	-	-	95	ns
			$V_{CC}=4.5\text{V}$	-	-	19	ns
			$V_{CC}=6.0\text{V}$	-	-	15	ns

### Transfer Characteristics 1

( $T_{amb}=25^{\circ}\text{C}$ , voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
positive-going threshold voltage	$V_{T+}$	$V_{CC}=2.0\text{V}$	0.7	1.18	1.5	V
		$V_{CC}=4.5\text{V}$	1.7	2.38	3.15	V
		$V_{CC}=6.0\text{V}$	2.1	3.14	4.2	V
negative-going threshold voltage	$V_{T-}$	$V_{CC}=2.0\text{V}$	0.3	0.52	0.9	V
		$V_{CC}=4.5\text{V}$	0.9	1.4	2.0	V
		$V_{CC}=6.0\text{V}$	1.2	1.89	2.6	V
hysteresis voltage	$V_H$	$V_{CC}=2.0\text{V}$	-	0.66	-	V
		$V_{CC}=4.5\text{V}$	-	0.98	-	V
		$V_{CC}=6.0\text{V}$	-	1.25	-	V

### Transfer Characteristics 2

( $T_{amb}=-20^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , voltages are referenced to GND (ground= 0V), unless otherwise specified )

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
positive-going threshold voltage	$V_{T+}$	$V_{CC}=2.0\text{V}$	0.7	-	1.5	V
		$V_{CC}=4.5\text{V}$	1.7	-	3.15	V
		$V_{CC}=6.0\text{V}$	2.1	-	4.2	V
negative-going threshold voltage	$V_{T-}$	$V_{CC}=2.0\text{V}$	0.3	-	0.9	V
		$V_{CC}=4.5\text{V}$	0.9	-	2.0	V
		$V_{CC}=6.0\text{V}$	1.2	-	2.6	V
hysteresis voltage	$V_H$	$V_{CC}=2.0\text{V}$	-	0.66	-	V
		$V_{CC}=4.5\text{V}$	-	0.98	-	V
		$V_{CC}=6.0\text{V}$	-	1.25	-	V



## Testing Circuit

### AC Testing Circuit

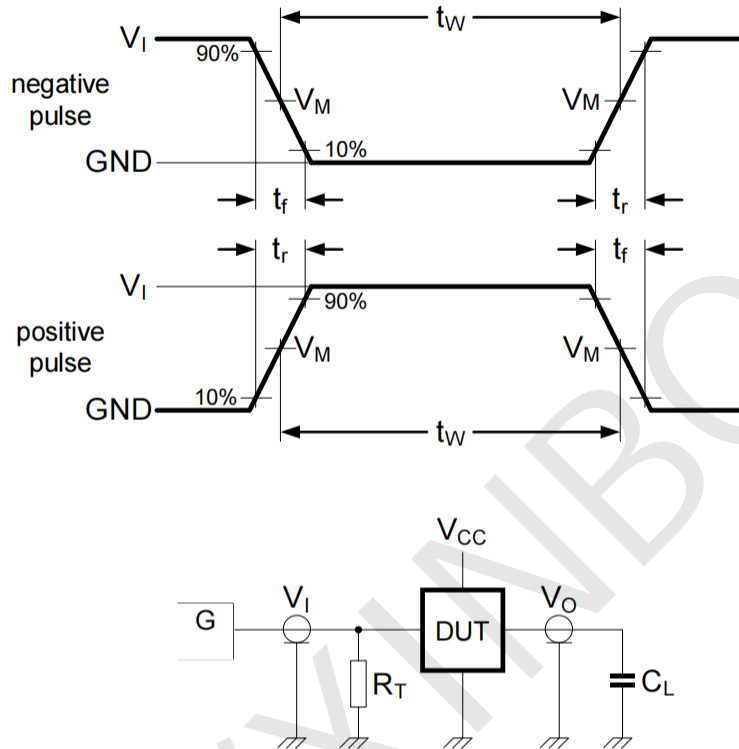


Figure 4. Test circuit for measuring switching times

Definitions for test circuit:

$C_L$ =load capacitance including jig and probe capacitance.

$R_T$ =termination resistance should be equal to the output impedance  $Z_o$  of the pulse generator.

AC Testing Waveforms

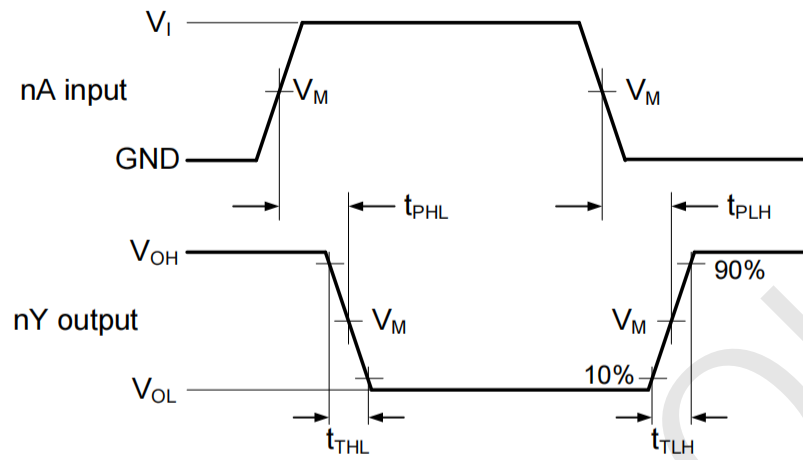


Figure 5. Input to output propagation delays

Transfer Characteristics Waveforms

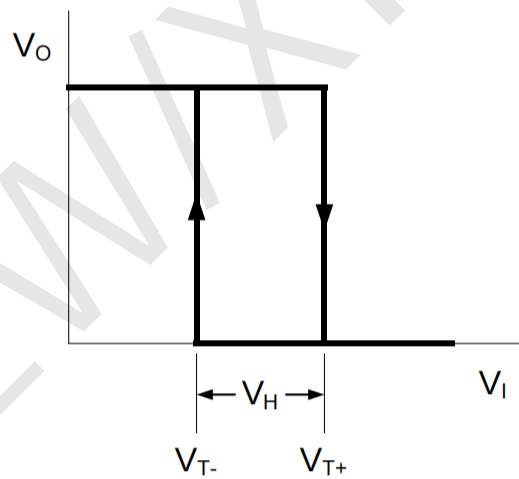


Figure 6. Transfer characteristics

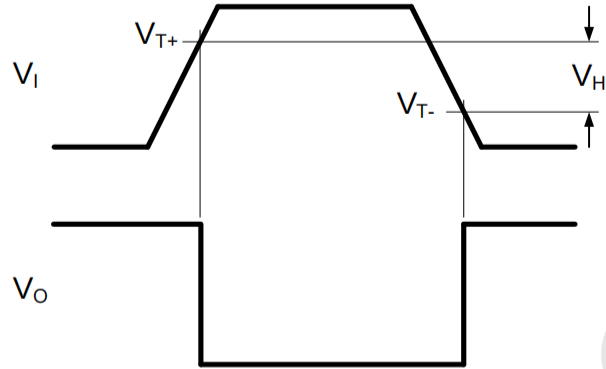


Figure 7. Transfer characteristics definitions

**Measurement Points**

Input	Output		
$V_M$	$V_M$	$V_X$	$V_Y$
$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$0.1 \times V_{CC}$	$0.9 \times V_{CC}$

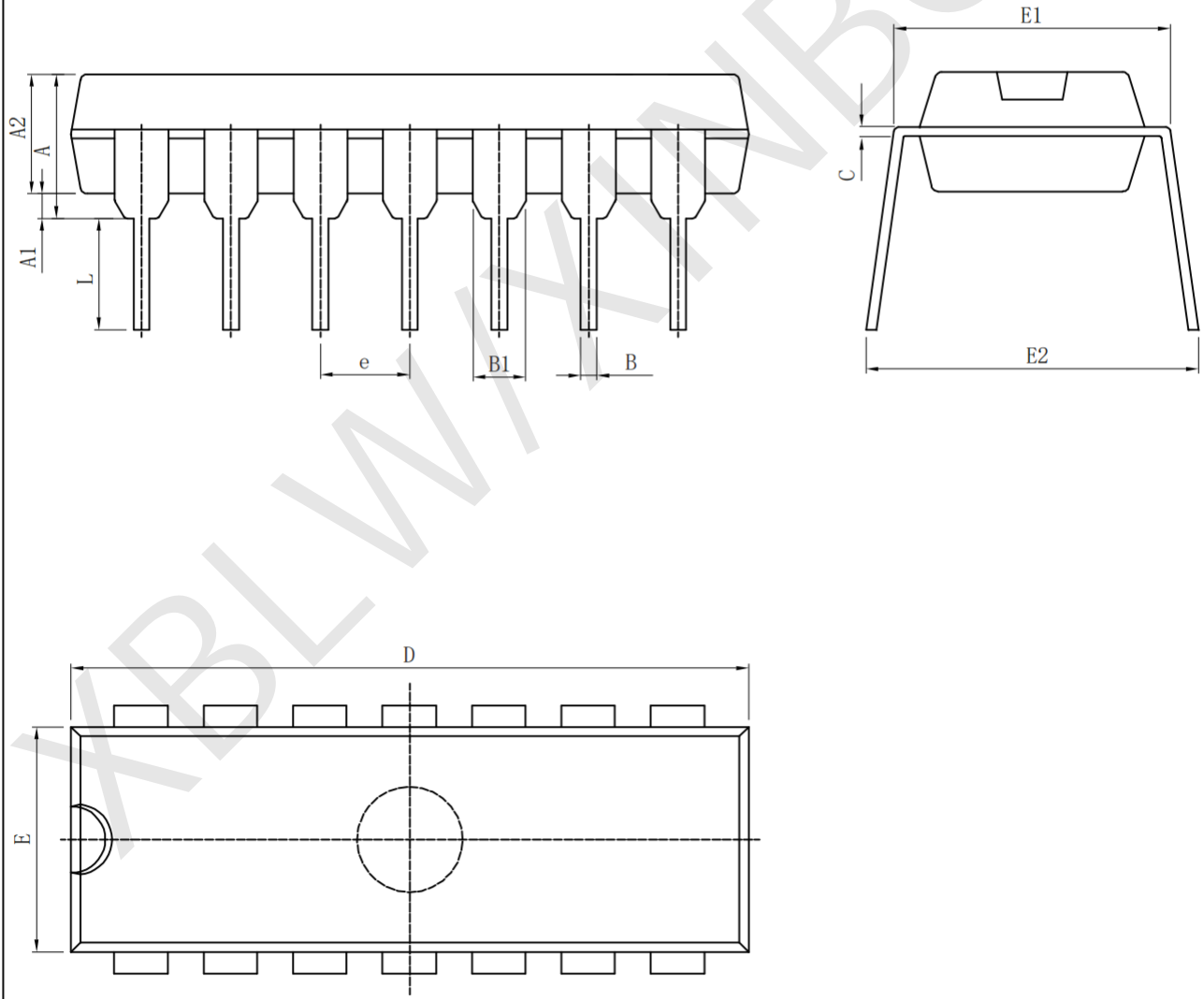
**Test Data**

Input		Load	Test
$V_I$	$t_r, t_f$	$C_L$	
$V_{CC}$	6.0ns	15pF, 50pF	$t_{PLH}, t_{PHL}$

**Package Information**

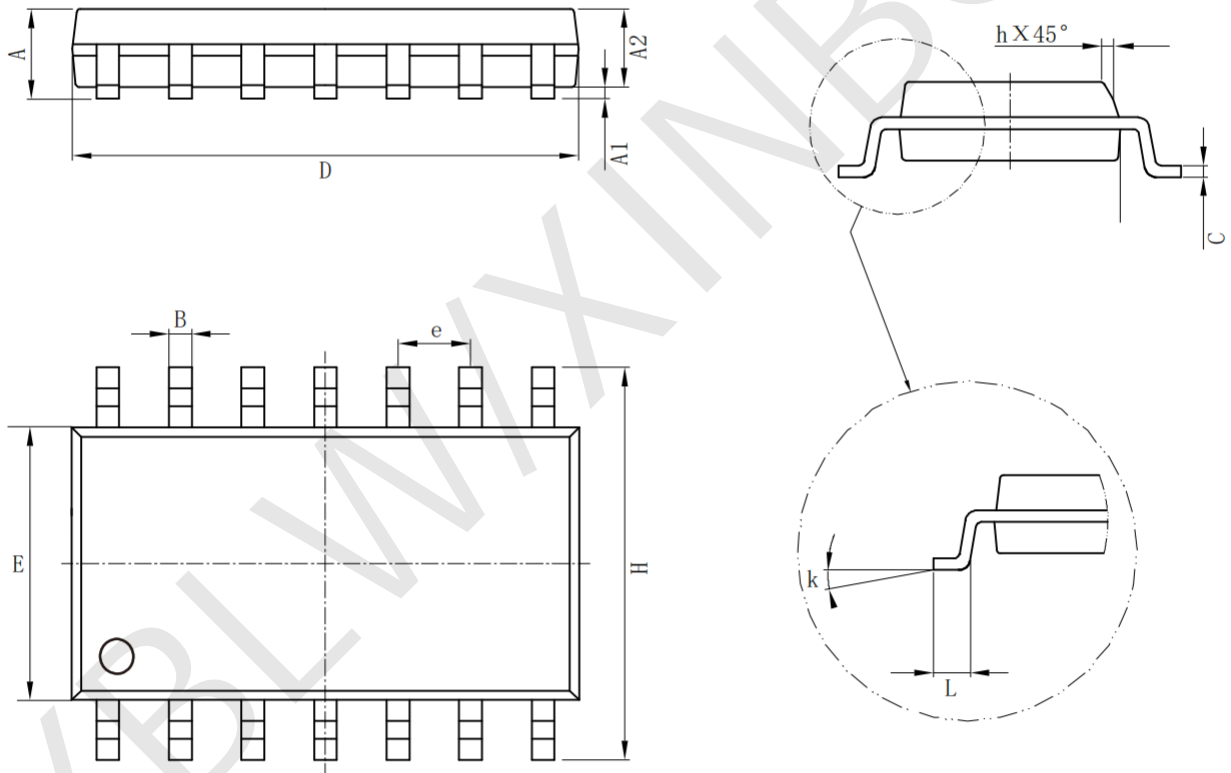
· DIP-14

Symbol	Size	Dimensions In Millimeters		Symbol	Size	Dimensions In Inches	
		Min (mm)	Max (mm)			Min (in)	Max (in)
A		3.710	4.310	A		0.146	0.170
A1		0.510		A1		0.020	
A2		3.200	3.600	A2		0.126	0.142
B		0.380	0.570	B		0.015	0.022
B1		1.524 (BSC)		B1		0.060 (BSC)	
C		0.204	0.360	C		0.008	0.014
D		18.800	19.200	D		0.740	0.756
E		6.200	6.600	E		0.244	0.260
E1		7.320	7.920	E1		0.288	0.312
e		2.540 (BSC)		e		0.100 (BSC)	
L		3.000	3.600	L		0.118	0.142
E2		8.400	9.000	E2		0.331	0.354



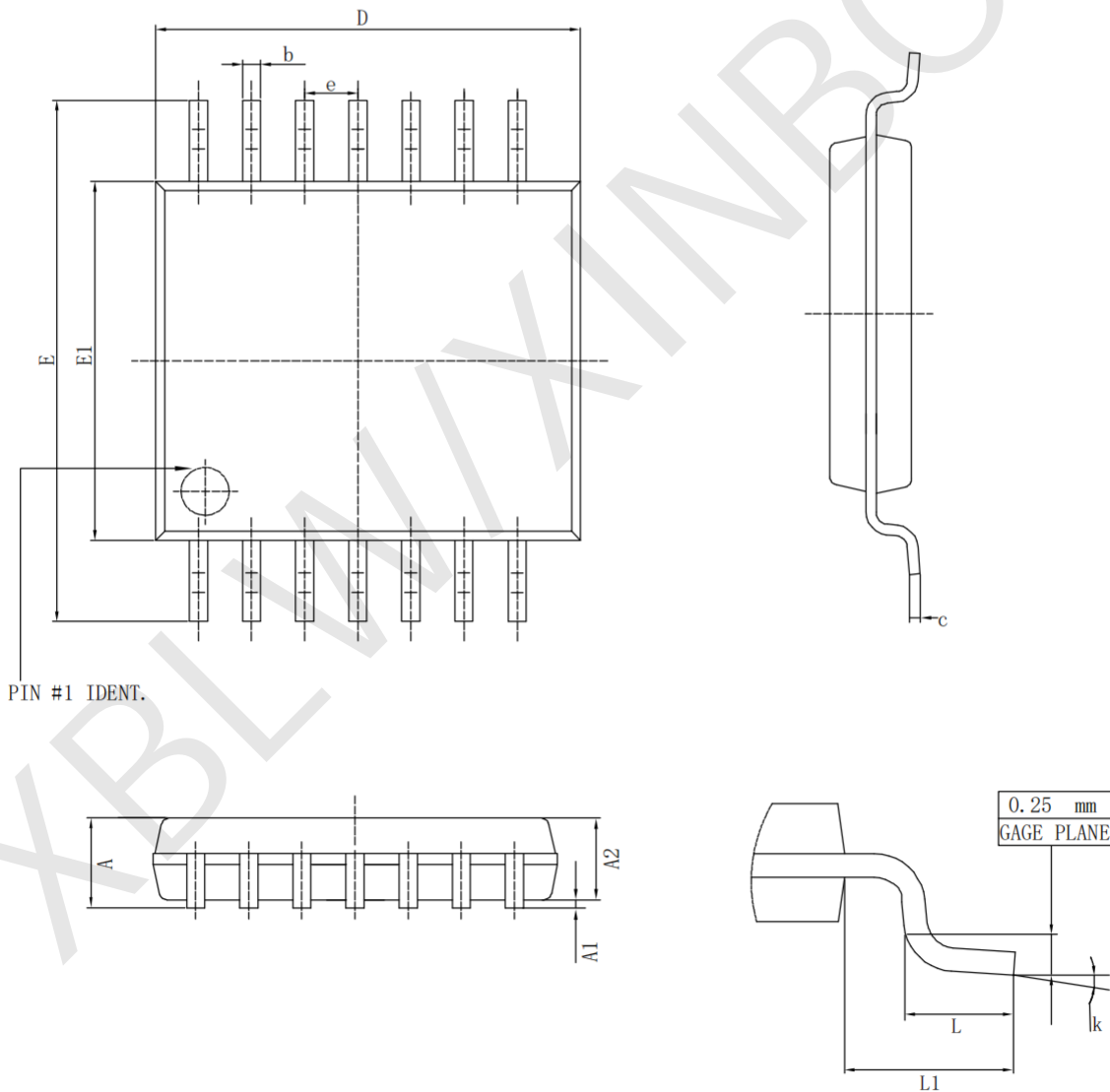
· SOP-14

Symbol	Dimensions In Millimeters		Symbol	Dimensions In Inches	
	Min( mm)	Max( mm)		Min( in)	Max( in)
A	1.350	1.750	A	0.050	0.068
A1	0.100	0.250	A1	0.004	0.009
A2	1.100	1.650	A2	0.040	0.060
B	0.330	0.510	B	0.010	0.020
C	0.190	0.250	C	0.007	0.009
D	8.550	8.750	D	0.330	0.340
E	3.800	4.000	E	0.150	0.150
e	1.27		e	0.05	
H	5.800	6.200	H	0.220	0.240
h	0.250	0.500	h	0.009	0.020
L	0.400	1.270	L	0.015	0.050
k	8° (max)		k	8° (max)	



· TSSOP-14

Symbol	Size	Dimensions In Millimeters		Symbol	Size	Dimensions In Inches	
		Min (mm)	Max (mm)			Min (in)	Max (in)
A			1.200	A			0.047
A1		0.050	0.150	A1		0.002	0.006
A2		0.800	1.050	A2		0.031	0.041
b		0.190	0.300	b		0.007	0.012
c		0.090	0.200	c		0.004	0.0089
D		4.900	5.100	D		0.193	0.201
E		6.200	6.600	E		0.244	0.260
E1		4.300	4.500	E1		0.169	0.176
e		0.65		e		0.0256	
L		0.450	0.750	L		0.018	0.030
L1		1.00		L1		0.039	
k		0°	8°	k		0°	8°



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