

Product Specification

XBLW SN74HC02

Quad 2-input Nor Gate

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Description

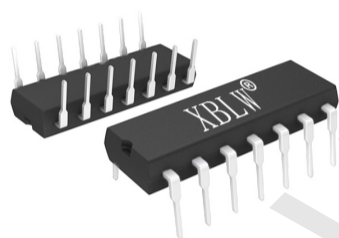
The SN74HC02 is a quad 2-input NOR gate. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

Features

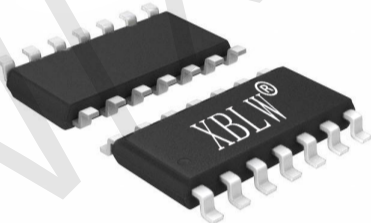
- Wide operating voltage range: 2 V to 6 V
- Specified from -40°C to +125°C
- Packaging information: DIP-14/SOP-14/TSSOP-14

Applications

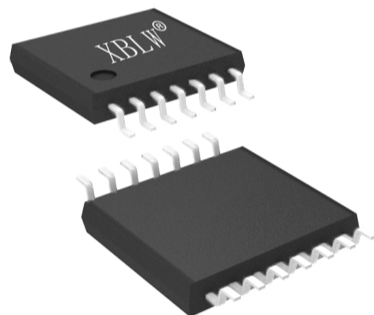
- Alarm / tamper detect circuit
- S-R latch



DIP-14



SOP-14



TSSOP-14

Ordering Information

Product Model	Package Type	Marking	Packing	Packing Qty
XBLW SN74HC02N	DIP-14	74HC02N	Tube	1000Pcs/Box
XBLW SN74HC02DTR	SOP-14	74HC02	Tape	2500Pcs/Reel
XBLW SN74HC02TDTR	TSSOP-14	74HC02	Tape	3000Pcs/Reel

Block Diagram

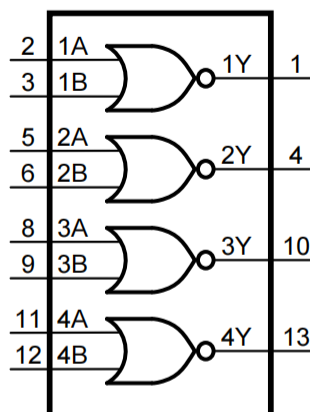


Figure 1. Logic symbol

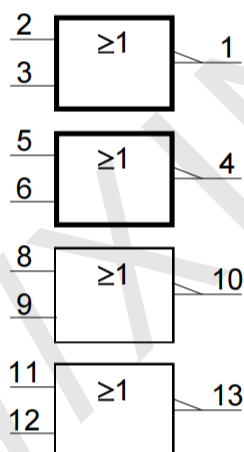


Figure 2. IEC logic symbol

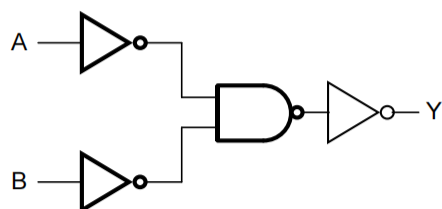
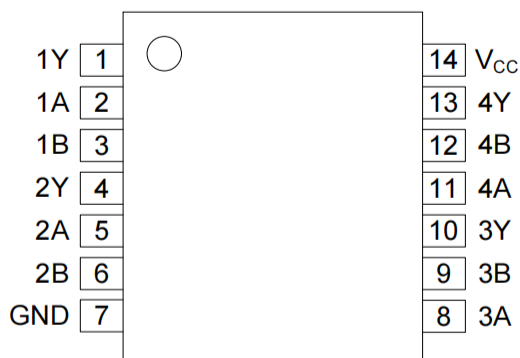


Figure 3. Logic diagram for one gate

Pin Configurations



Pin Description

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

Function Table

Input		Output
nA	nB	nY
L	L	H
X	H	L
H	X	L

Note: H=HIGH voltage level; L=LOW voltage level; X=don't care.

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 $V_I > V_{CC}+0.5V$	-	± 20	mA
output clamping current	I_{OK}	$V_O < -0.5V$ or $V_O > V_{CC}+0.5V$	-	± 20	mA
output current	I_O	$-0.5V < V_O < V_{CC}+0.5V$	-	± 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	245	°C
			SOP/TSSOP	260	°C

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
input transition rise and fall rate	$\Delta t/\Delta V$	$V_{CC}=2.0V$	-	-	625	ns/V
		$V_{CC}=4.5V$	-	1.67	139	ns/V
		$V_{CC}=6.0V$	-	-	83	ns/V
ambient temperature	T_{amb}	-	-40	-	+125	°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 input voltage	V_{IH}	$V_{CC}=2.0\text{V}$	1.5	1.2	-	V
		$V_{CC}=4.5\text{V}$	3.15	2.4	-	V
		$V_{CC}=6.0\text{V}$	4.2	3.2	-	V
LOW-level input voltage	V_{IL}	$V_{CC}=2.0\text{V}$	-	0.8	0.5	V
		$V_{CC}=4.5\text{V}$	-	2.1	1.35	V
		$V_{CC}=6.0\text{V}$	-	2.8	1.8	V
HIGH-level output voltage	V_{OH}	$V_I=V_{IH}$ or V_{IL} $I_O=-20\mu\text{A}; V_{CC}=2.0\text{V}$	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}	$V_I=V_{IH}$ or V_{IL} $I_O=20\mu\text{A}; V_{CC}=2.0\text{V}$	-	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; $V_{CC}=6.0\text{V}$	-	-	± 1	μA
supply current	I_{CC}	$V_I=V_{CC}$ or GND; $I_O=0\text{A}; V_{CC}=6.0\text{V}$	-	-	2.0	μA
input capacitance	C_i	-	-	3.5	-	pF

DC Characteristics 2

($T_{amb} = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
HIGH-level input voltage	V_{IH}	$V_{CC}=2.0\text{V}$	1.5	-	-	V
		$V_{CC}=4.5\text{V}$	3.15	-	-	V
		$V_{CC}=6.0\text{V}$	4.2	-	-	V
LOW-level input voltage	V_{IL}	$V_{CC}=2.0\text{V}$	-	-	0.5	V
		$V_{CC}=4.5\text{V}$	-	-	1.35	V
		$V_{CC}=6.0\text{V}$	-	-	1.8	V
HIGH-level output voltage	V_{OH}	$I_O = -20\mu\text{A}; V_{CC}=2.0\text{V}$	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}	$I_O = 20\mu\text{A}; V_{CC}=2.0\text{V}$	-	-	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; $V_{CC}=6.0\text{V}$	-	-	± 1	μA
supply current	I_{CC}	$V_I = V_{CC}$ or GND; $I_O=0\text{A}; V_{CC}=6.0\text{V}$	-	-	20	μA

DC Characteristics 3

($T_{amb} = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
HIGH-level input voltage	V_{IH}	$V_{CC}=2.0\text{V}$	1.5	-	-	V
		$V_{CC}=4.5\text{V}$	3.15	-	-	V
		$V_{CC}=6.0\text{V}$	4.2	-	-	V
LOW-level input voltage	V_{IL}	$V_{CC}=2.0\text{V}$	-	-	0.5	V
		$V_{CC}=4.5\text{V}$	-	-	1.35	V
		$V_{CC}=6.0\text{V}$	-	-	1.8	V
HIGH-level output voltage	V_{OH}	$V_I = V_{IH} \text{ or } V_{IL}$	$I_O = -20\mu\text{A}; V_{CC}=2.0\text{V}$	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
			$I_O = -4.0\text{mA}; V_{CC}=4.5\text{V}$	3.7	-	V
			$I_O = -5.2\text{mA}; V_{CC}=6.0\text{V}$	5.2	-	V
LOW-level output voltage	V_{OL}	$V_I = V_{IH} \text{ or } V_{IL}$	$I_O = 20\mu\text{A}; V_{CC}=2.0\text{V}$	-	-	0.1
			$I_O = 20\mu\text{A}; V_{CC}=4.5\text{V}$	-	-	0.1
			$I_O = 20\mu\text{A}; V_{CC}=6.0\text{V}$	-	-	0.1
			$I_O = 4.0\text{mA}; V_{CC}=4.5\text{V}$	-	-	0.4
			$I_O = 5.2\text{mA}; V_{CC}=6.0\text{V}$	-	-	0.4
input leakage current	I_I	$V_I = V_{CC} \text{ or } \text{GND}; V_{CC}=6.0\text{V}$	-	-	± 1	μA
supply current	I_{CC}	$V_I = V_{CC} \text{ or } \text{GND}; I_O=0\text{A}; V_{CC}=6.0\text{V}$	-	-	40	μA

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 _{pd}	see Figure 5 ^[1]	V _{CC} =2.0V	-	25	90	ns
			V _{CC} =4.5V	-	9	18	ns
			V _{CC} =5.0V;C _L =15pF	-	7	-	ns
			V _{CC} =6.0V	-	7	15	ns
transition time	t _t	see Figure 5 ^[2]	V _{CC} =2.0V	-	19	75	ns
			V _{CC} =4.5V	-	7	15	ns
			V _{CC} =6.0V	-	6	13	ns
power dissipation capacitance	C _{PD}	per package; V _I = GND to V _{CC} ^[3]		-	22	-	pF

Note:

[1] t_{pd} is the same as t_{PLH} and t_{PHL} .

[2] t_t is the same as t_{THL} and t_{TLH} .

[3] C_{PD} is used to determine the dynamic power dissipation (P_D in uW).

$P_D = (C_{PD} \times V_{CC}^2 \times f_i \times N) + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where: f_i =input frequency in MHz;

f_o =output frequency in MHz;

C_L =output load capacitance in pF; V_{CC} =supply voltage in V;

N =number of inputs switching; $\Sigma(C_L \times V_{CC}^2 \times f_o)$ =sum of outputs.

AC Characteristics 2

($T_{amb} = -40^{\circ}\text{C}$ 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_{pd}	see Figure 5 ^[1]	$V_{CC}=2.0\text{V}$	-	-	115 ns
			$V_{CC}=4.5\text{V}$	-	-	23 ns
			$V_{CC}=6.0\text{V}$	-	-	20 ns
transition time	t_t	see Figure 5 ^[2]	$V_{CC}=2.0\text{V}$	-	-	95 ns
			$V_{CC}=4.5\text{V}$	-	-	19 ns
			$V_{CC}=6.0\text{V}$	-	-	16 ns

Note:

[1] t_{pd} is the same as t_{PLH} and t_{PHL} .

[2] t_t is the same as t_{THL} and t_{TLH} .

AC Characteristics 3

($T_{amb} = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
nA, nB to nY Propagation delay	t_{pd}	see Figure 5 ^[1]	$V_{CC}=2.0\text{V}$	-	-	135 ns
			$V_{CC}=4.5\text{V}$	-	-	27 ns
			$V_{CC}=6.0\text{V}$	-	-	23 ns
transition time	t_t	see Figure 5 ^[2]	$V_{CC}=2.0\text{V}$	-	-	110 ns
			$V_{CC}=4.5\text{V}$	-	-	22 ns
			$V_{CC}=6.0\text{V}$	-	-	19 ns

Note:

[1] t_{pd} is the same as t_{PLH} and t_{PHL} .

[2] t_t is the same as t_{THL} and t_{TLH} .

Testing Circuit

AC Testing Circuit

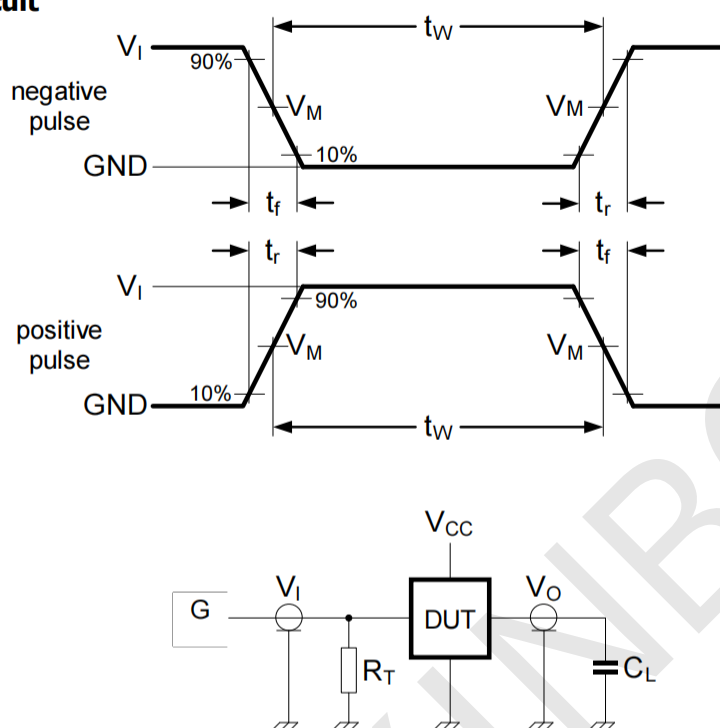


Figure 4. Test circuit for measuring switching times

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

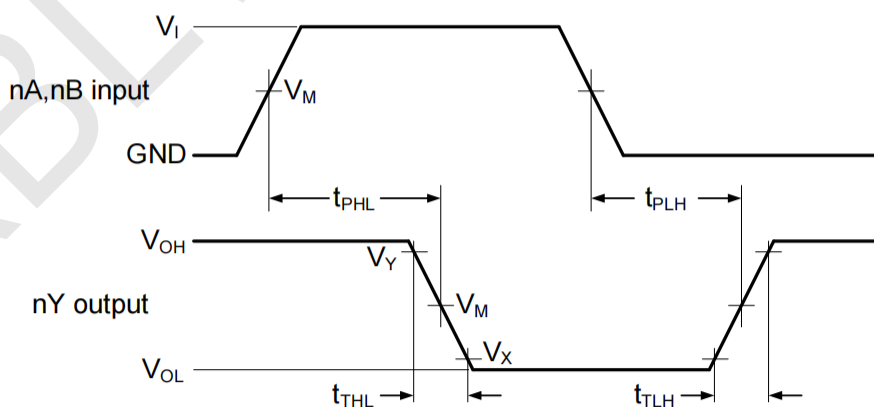


Figure 5. Input to output propagation delays

Measurement Points

Type	Input	Output		
	V_M	V_M	V_X	V_Y
SN74HC02	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$0.1 \times V_{CC}$	$0.9 \times V_{CC}$

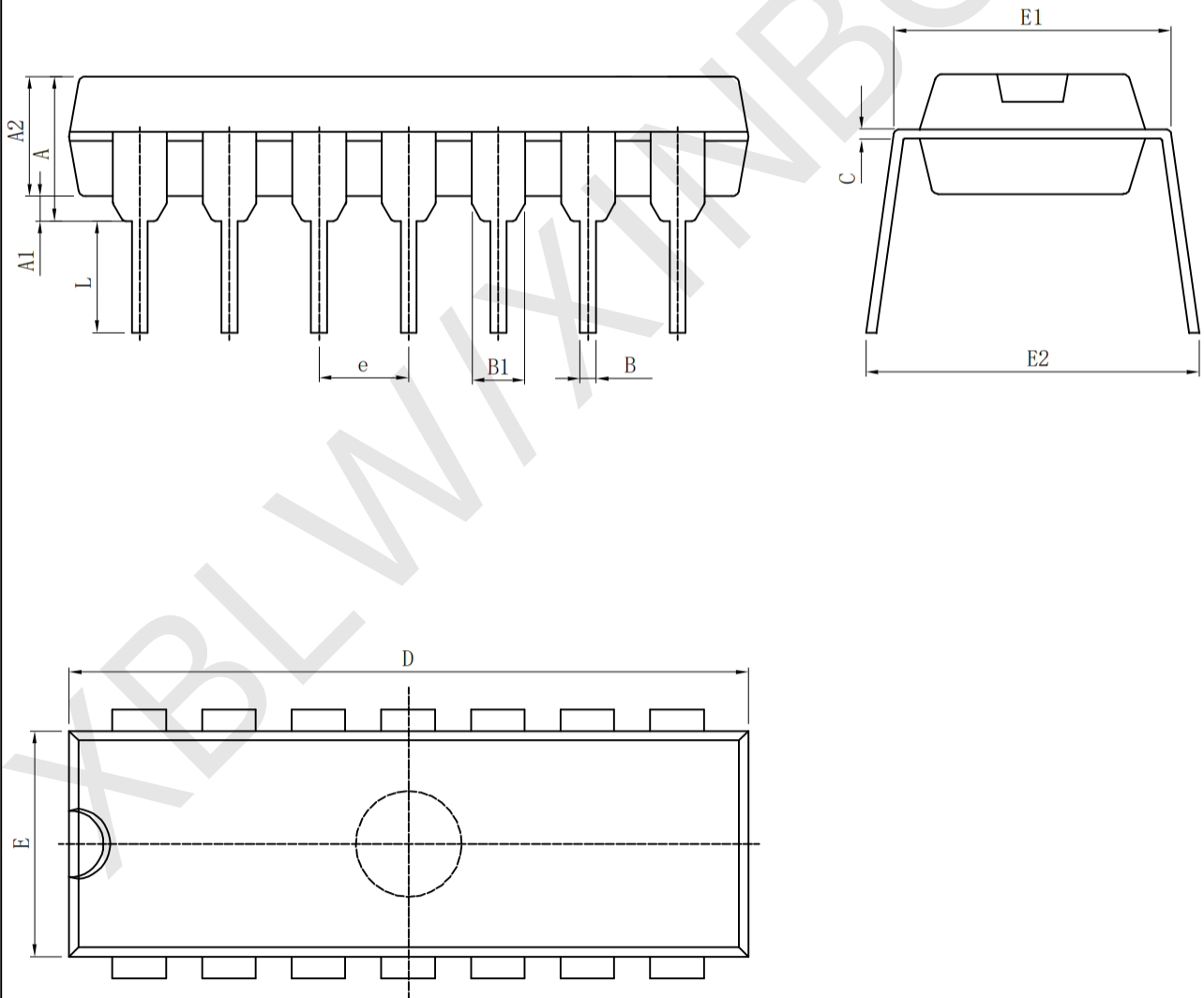
Test Data

Type	Input		Load	Test
	V_I	t_r, t_f	C_L	
SN74HC02	V_{CC}	6.0ns	15pF, 50pF	t_{PLH}, t_{PHL}

Package Information

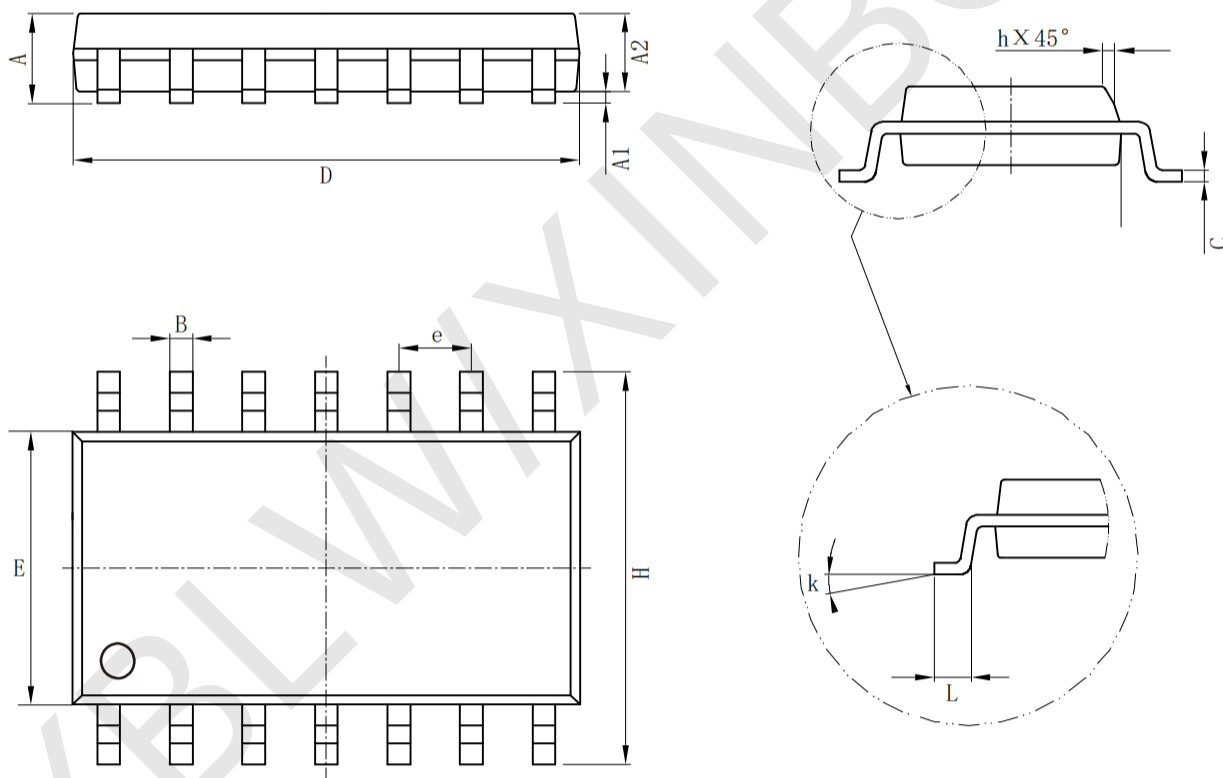
• DIP-14

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



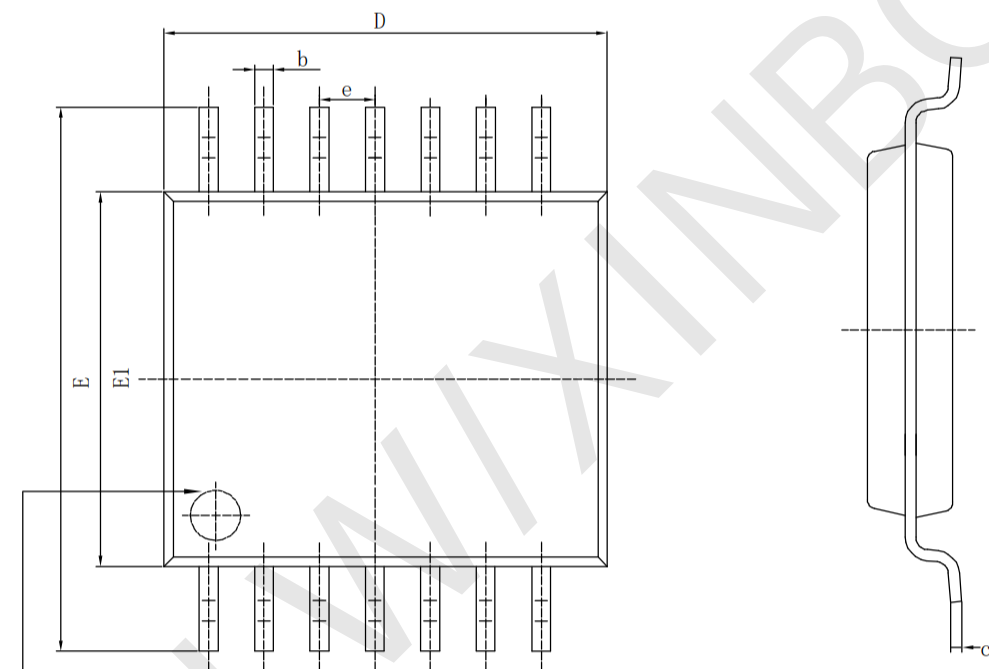
· SOP-14

Size Symbol	Dimensions In Millimeters		Size 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)	

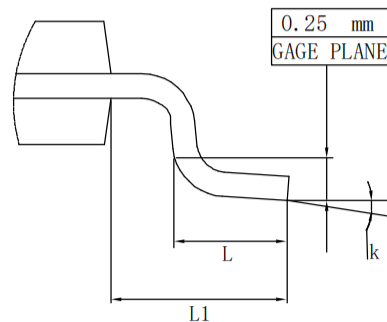
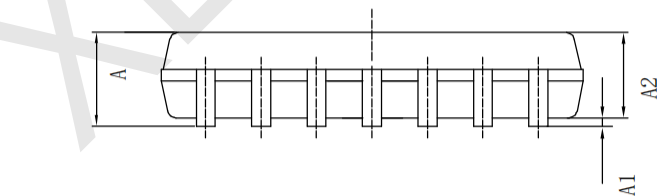


· TSSOP-14

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°



PIN #1 IDENT.



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