

Product Specification

XBLW SN74LS390

Dual Decade Ripple Counter

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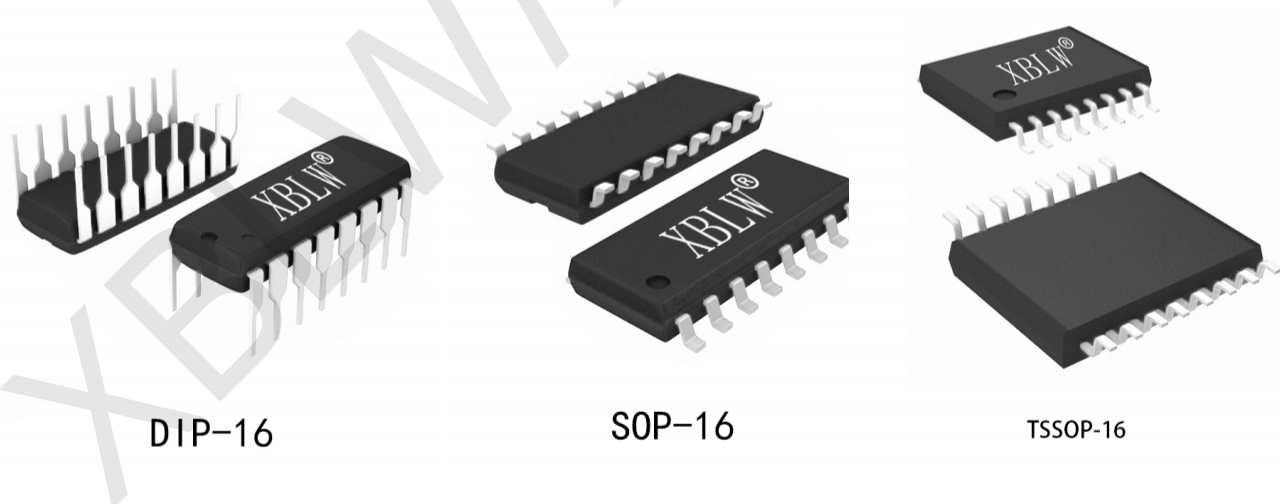
Description

The SN74LS390 is a dual 4-bit decade ripple counter divided into four separately clocked sections. The counters have two divide-by-2 sections and two divide-by-5 sections. These sections share an asynchronous master reset input ($\overline{nMR}$) and can be used in a BCD decade or bi-quinary configuration. If master reset inputs 1MR and 2MR are used to clear all 8 bits of the counter simultaneously, numerous counting configurations are possible within one package. Section clocks $\overline{nCP0}$ and $\overline{nCP1}$, allow ripple counter or frequency division applications of divide-by-2, 4, 5, 10, 20, 25, 50 or 100.

The HIGH-to-LOW transition of the clock inputs $\overline{nCP0}$ and $\overline{nCP1}$ trigger each section. For BCD decade operation, the $nQ0$ output is connected to the $\overline{nCP1}$ input of the divide-by-5 section. For bi-quinary decade operation, the $nQ3$ output is connected to the $\overline{nCP0}$ input and $nQ0$ becomes the decade output. A HIGH on the $\overline{nMR}$ input overrides the clocks and sets the four outputs LOW. Inputs include clamp diodes. It enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

Features

- Two BCD decade or bi-quinary counters
- One device can be configured to divide-by-2, 4, 5, 10, 20, 25, 50 or 100
- Two master reset inputs to clear each decade counter individually
- Specified from -20°C to +85°C
- Packaging information: DIP-16/SOP-16/TSSOP-16



Ordering Information

Product Model	Package Type	Marking	Packing	Packing Qty
XBLW SN74LS390N	DIP-16	74LS390N	Tube	1000Pcs/Box
XBLW SN74LS390DTR	SOP-16	74LS390	Tape	2500Pcs/Reel
XBLW SN74LS390TDTR	TSSOP-16	74LS390	Tape	3000Pcs/Reel

Block Diagram

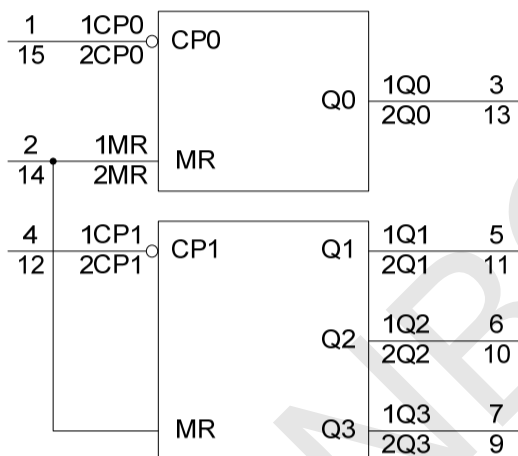


Figure 1. Logic symbol

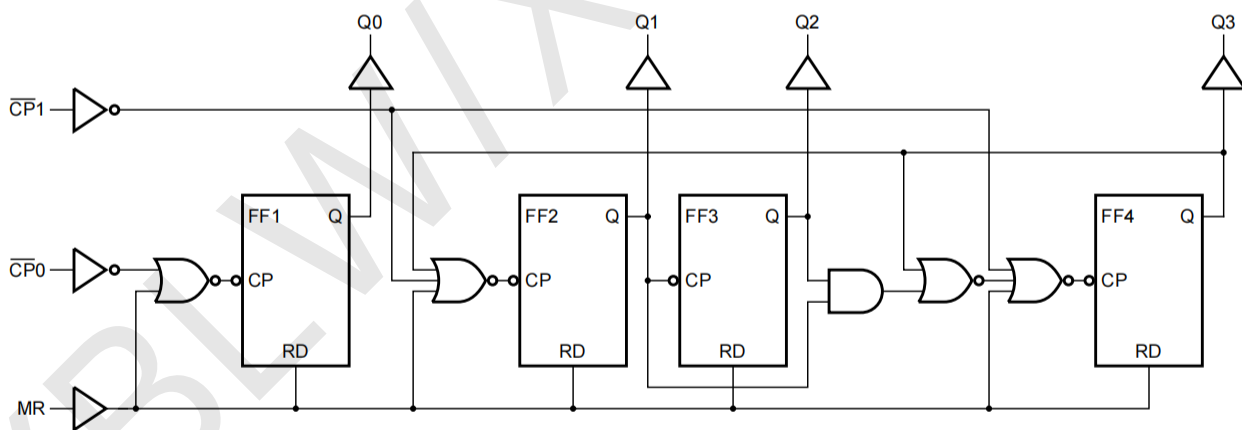
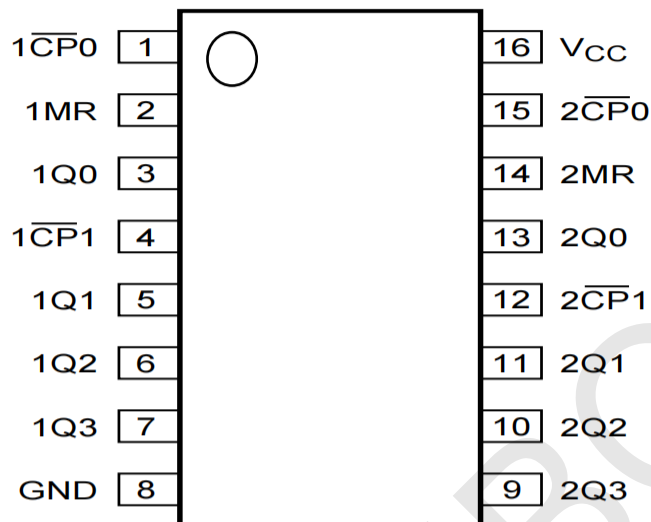


Figure 2. Logic diagram (one counter)

Pin Configurations



Pin Description

Pin No.	Pin Name	Description
1	1CP0	clock input divide-by-2 section (HIGH-to-LOW; edge-triggered)
2	1MR	asynchronous master reset input (active HIGH)
3	1Q0	flip-flop outputs
4	1CP1	clock input divide-by-5 section (HIGH-to-LOW; edge-triggered)
5	1Q1	flip-flop outputs
6	1Q2	flip-flop outputs
7	1Q3	flip-flop outputs
8	GND	ground (0V)
9	2Q3	flip-flop outputs
10	2Q2	flip-flop outputs
11	2Q1	flip-flop outputs
12	2CP1	clock input divide-by-5 section (HIGH-to-LOW; edge-triggered)
13	2Q0	flip-flop outputs
14	2MR	asynchronous master reset input (active HIGH)
15	2CP0	clock input divide-by-2 section (HIGH-to-LOW; edge-triggered)
16	VCC	supply voltage

Function Table

BCD Count Sequence

Count	Output			
	nQ0	nQ1	nQ2	nQ3
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H

Note: Output nQ0 connected to $\overline{nCP1}$; counter input on $\overline{nCP0}$. H=HIGH voltage level;
L=LOW voltage level;

Bi-quinary Count Sequence

Count	Output			
	nQ0	nQ1	nQ2	nQ3
0	L	L	L	L
1	L	H	L	L
2	L	L	H	L
3	L	H	H	L
4	L	L	L	H
5	H	H	L	L
6	H	L	L	L
7	H	H	H	L
8	H	L	H	L
9	H	H	L	H

Note: Output nQ3 connected to $\overline{nCP0}$; counter input on $\overline{nCP1}$. H=HIGH voltage level;
L=LOW voltage level;

Electrical Parameter

Absolute Maximum Ratings

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

Characteristic	Symbol	Conditions	Min.	Max.	Unit
supply voltage	V_{CC}	-	-0.5	+7.0	V
input clamping current	I_{IK}	$V_I < -0.5\text{V}$ or $V_I > V_{CC} + 0.5\text{V}$	-	± 20	mA
output clamping current	I_{OK}	$V_I < -0.5\text{V}$ or $V_O > V_{CC} + 0.5\text{V}$	-	± 20	mA
output current	I_O	$0.5\text{V} < V_O < V_{CC} + 0.5\text{V}$	-	± 25	mA
supply current	I_{CC}	-	-	+50	mA
ground current	I_{GND}	-	-50	-	mA
storage temperature	T_{stg}	-	-65	+150	$^{\circ}\text{C}$
soldering temperature	T_L	10s	DIP	245	$^{\circ}\text{C}$
			SOP/TSSOP	260	$^{\circ}\text{C}$

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
ambient temperature	T_{amb}	-	-20	-	+85	$^{\circ}\text{C}$

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} =2.0V		1.5	1.2	-	V
		V _{CC} =4.5V		3.15	2.4	-	V
		V _{CC} =6.0V		4.2	3.2	-	V
LOW-level input voltage	V _{IL}	V _{CC} =2.0V		-	0.8	0.5	V
		V _{CC} =4.5V		-	2.1	1.35	V
		V _{CC} =6.0V		-	2.8	1.8	V
HIGH-level output voltage	V _{OH}	V _I =V _{IH} or V _{IL}	I _O =-20uA; V _{CC} =2.0V	1.9	2.0	-	V
			I _O =-20uA; V _{CC} =4.5V	4.4	4.5	-	V
			I _O =-20uA; V _{CC} =6.0V	5.9	6.0	-	V
			I _O =-4.0mA; V _{CC} =4.5V	3.98	4.32	-	V
			I _O =-5.2mA; V _{CC} =6.0V	5.48	5.81	-	V
LOW-level output voltage	V _{OL}	V _I =V _{IH} or V _{IL}	I _O =20uA; V _{CC} =2.0V	-	0	0.1	V
			I _O =20uA; V _{CC} =4.5V	-	0	0.1	V
			I _O =20uA; V _{CC} =6.0V	-	0	0.1	V
			I _O =4.0mA; V _{CC} =4.5V	-	0.15	0.26	V
			I _O =5.2mA; V _{CC} =6.0V	-	0.16	0.26	V
input leakage current	I _I	V _I =V _{CC} or GND; V _{CC} =6.0V		-	-	±1	uA
supply current	I _{CC}	V _I =V _{CC} or GND; I _O =0A; V _{CC} =6.0V		-	-	8	uA

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 input voltage	V _{IH}	V _{CC} =2.0V		1.5	-	-	V
		V _{CC} =4.5V		3.15	-	-	V
		V _{CC} =6.0V		4.2	-	-	V
LOW-level input voltage	V _{IL}	V _{CC} =2.0V		-	-	0.5	V
		V _{CC} =4.5V		-	-	1.35	V
		V _{CC} =6.0V		-	-	1.8	V
HIGH-level output voltage	V _{OH}	V _I =V _{IH} or V _{IL}	I _O =-20uA; V _{CC} =2.0V	1.9	-	-	V
			I _O =-20uA; V _{CC} =4.5V	4.4	-	-	V
			I _O =-20uA; V _{CC} =6.0V	5.9	-	-	V
			I _O =-4.0mA; V _{CC} =4.5V	3.84	-	-	V
			I _O =-5.2mA; V _{CC} =6.0V	5.34	-	-	V
LOW-level output voltage	V _{OL}	V _I =V _{IH} or V _{IL}	I _O =20uA; V _{CC} =2.0V	-	-	0.1	V
			I _O =20uA; V _{CC} =4.5V	-	-	0.1	V
			I _O =20uA; V _{CC} =6.0V	-	-	0.1	V
			I _O =4.0mA; V _{CC} =4.5V	-	-	0.33	V
			I _O =5.2mA; V _{CC} =6.0V	-	-	0.33	V
input leakage current	I _I	V _I =V _{CC} or GND; V _{CC} =6.0V		-	-	±1.0	uA
supply current	I _{CC}	V _I =V _{CC} or GND; I _O =0A; V _{CC} =6.0V		-	-	80	uA

AC Characteristics 1

($T_{amb}=25^{\circ}\text{C}$, $GND=0V$, $C_L=50\text{pF}$, unless otherwise specified)

Parameter	Symbol	Conditions		Min.	Typ. ^[1]	Max.	Unit
propagation delay	t _{PLH} , t _{PHL}	$\overline{n}$ CPO to nQ0; see Figure 4	V _{CC} =2.0V	-	47	145	ns
			V _{CC} =4.5V	-	17	29	ns
			V _{CC} =5.0V; C _L = 15pF	-	14	-	ns
			V _{CC} =6.0V	-	14	25	ns
		$\overline{n}$ CP1 to nQ1; see Figure 4	V _{CC} =2.0V	-	50	155	ns
			V _{CC} =4.5V	-	18	31	ns
			V _{CC} =5.0V; C _L = 15pF	-	15	-	ns
			V _{CC} =6.0V	-	14	26	ns
		$\overline{n}$ CP1 to nQ2; see Figure 4	V _{CC} =2.0V	-	74	210	ns
			V _{CC} =4.5V	-	27	42	ns
			V _{CC} =5.0V; C _L = 15pF	-	23	-	ns
			V _{CC} =6.0V	-	22	36	ns
		$\overline{n}$ CP1 to nQ3; see Figure 4	V _{CC} =2.0V	-	50	155	ns
			V _{CC} =4.5V	-	18	31	ns
			V _{CC} =5.0V; C _L = 15pF	-	15	-	ns
			V _{CC} =6.0V	-	14	26	ns
HIGH to LOW Propagation delay	t _{PHL}	nMR to nQn; see Figure 5	V _{CC} =2.0V	-	52	165	ns
			V _{CC} =4.5V	-	19	33	ns
			V _{CC} =5.0V; C _L = 15pF	-	16	-	ns
			V _{CC} =6.0V	-	15	28	ns
transition time	t _{THL} , t _{TLH}	nQn; see Figure 4	V _{CC} =2.0V	-	19	75	ns
			V _{CC} =4.5V	-	7	15	ns
			V _{CC} =6.0V	-	6	13	ns
pulse width	t _w	$\overline{n}$ CP 0 , n CP1 ; HIGH or LOW; see Figure 4	V _{CC} =2.0V	80	19	-	ns
			V _{CC} =4.5V	16	7	-	ns
			V _{CC} =6.0V	14	6	-	ns
		nMR HIGH; see Figure 5	V _{CC} =2.0V	80	28	-	ns
			V _{CC} =4.5V	17	10	-	ns
			V _{CC} =6.0V	14	8	-	ns
recovery time	t _{rec}	nMR to $\overline{n}$ CPn ; see Figure 5	V _{CC} =2.0V	75	22	-	ns
			V _{CC} =4.5V	15	8	-	ns
			V _{CC} =6.0V	13	6	-	ns
maximum frequency	f _{max}	$\overline{n}$ CPn ; see Figure 4	V _{CC} =2.0V	6	20	-	MHz
			V _{CC} =4.5V	30	60	-	MHz
			V _{CC} =5.0V; C _L = 15pF	-	66	-	MHz
			V _{CC} =6.0V	35	71	-	MHz

Note:

[1] All typical values are measured at $T_{amb}=25^{\circ}\text{C}$.

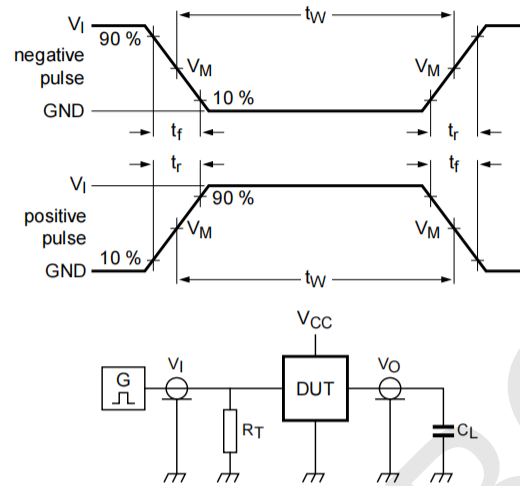
AC Characteristics 2

(T_{amb}=-20°C to +85°C, GND=0V, C_L=50pF, unless otherwise specified)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
propagation delay	t _{PLH} , t _{PHL}	n CPO to nQ0; see Figure 4	V _{CC} =2.0V	-	-	180	ns
			V _{CC} =4.5V	-	-	36	ns
			V _{CC} =6.0V	-	-	31	ns
		n CP1 to nQ1; see Figure 4	V _{CC} =2.0V	-	-	195	ns
			V _{CC} =4.5V	-	-	39	ns
			V _{CC} =6.0V	-	-	33	ns
		n CP1 to nQ2; see Figure 4	V _{CC} =2.0V	-	-	265	ns
			V _{CC} =4.5V	-	-	53	ns
			V _{CC} =6.0V	-	-	45	ns
		n CP1 to nQ3; see Figure 4	V _{CC} =2.0V	-	-	195	ns
			V _{CC} =4.5V	-	-	39	ns
			V _{CC} =6.0V	-	-	33	ns
HIGH to LOW Propagation delay	t _{PHL}	nMR to nQn; see Figure 5	V _{CC} =2.0V	-	-	205	ns
			V _{CC} =4.5V	-	-	41	ns
			V _{CC} =6.0V	-	-	35	ns
transition time	t _{THL} , t _{TLH}	nQn; see Figure 4	V _{CC} =2.0V	-	-	95	ns
			V _{CC} =4.5V	-	-	19	ns
			V _{CC} =6.0V	-	-	16	ns
pulse width	t _w	n CP 0 , n CP1 ; HIGH or LOW; see Figure 4	V _{CC} =2.0V	100	-	-	ns
			V _{CC} =4.5V	20	-	-	ns
			V _{CC} =6.0V	17	-	-	ns
		nMR HIGH; see Figure 5	V _{CC} =2.0V	105	-	-	ns
			V _{CC} =4.5V	21	-	-	ns
			V _{CC} =6.0V	18	-	-	ns
recovery time	t _{rec}	nMR to nCPn ; see Figure 5	V _{CC} =2.0V	95	-	-	ns
			V _{CC} =4.5V	19	-	-	ns
			V _{CC} =6.0V	16	-	-	ns
maximum frequency	f _{max}	nCPn ; see Figure 4	V _{CC} =2.0V	4.8	-	-	MHz
			V _{CC} =4.5V	24	-	-	MHz
			V _{CC} =6.0V	28	-	-	MHz

Testing Circuit

AC Testing Circuit



Definitions test circuit:

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

C_L =load capacitance including jig and probe capacitance

Figure 3. Test circuit for measuring switching times

AC Testing Waveforms

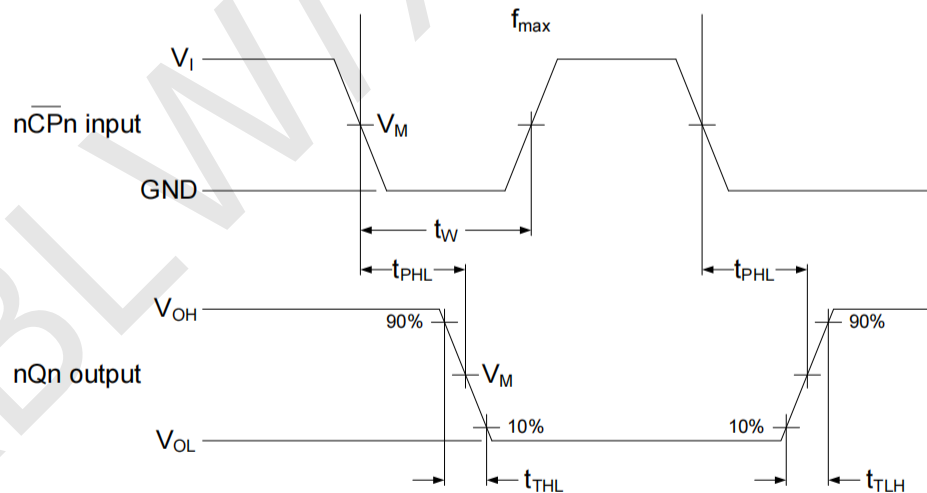


Figure 4. The clock input ($\overline{nCPn}$) to output (nQn) propagation delays, output transition time, clock pulse width and maximum clock frequency

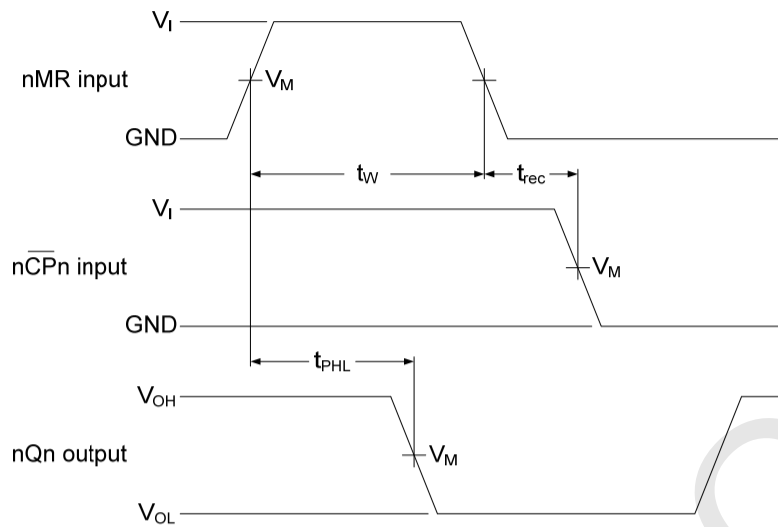


Figure 5. The master reset (nMR) pulse width, master reset to output (nQn) propagation delays and master reset to clock (nCPn) recovery time

Measurement Points

Type	Input	Output
	V_M	V_M
SN74LS390	$0.5V_{CC}$	$0.5V_{CC}$

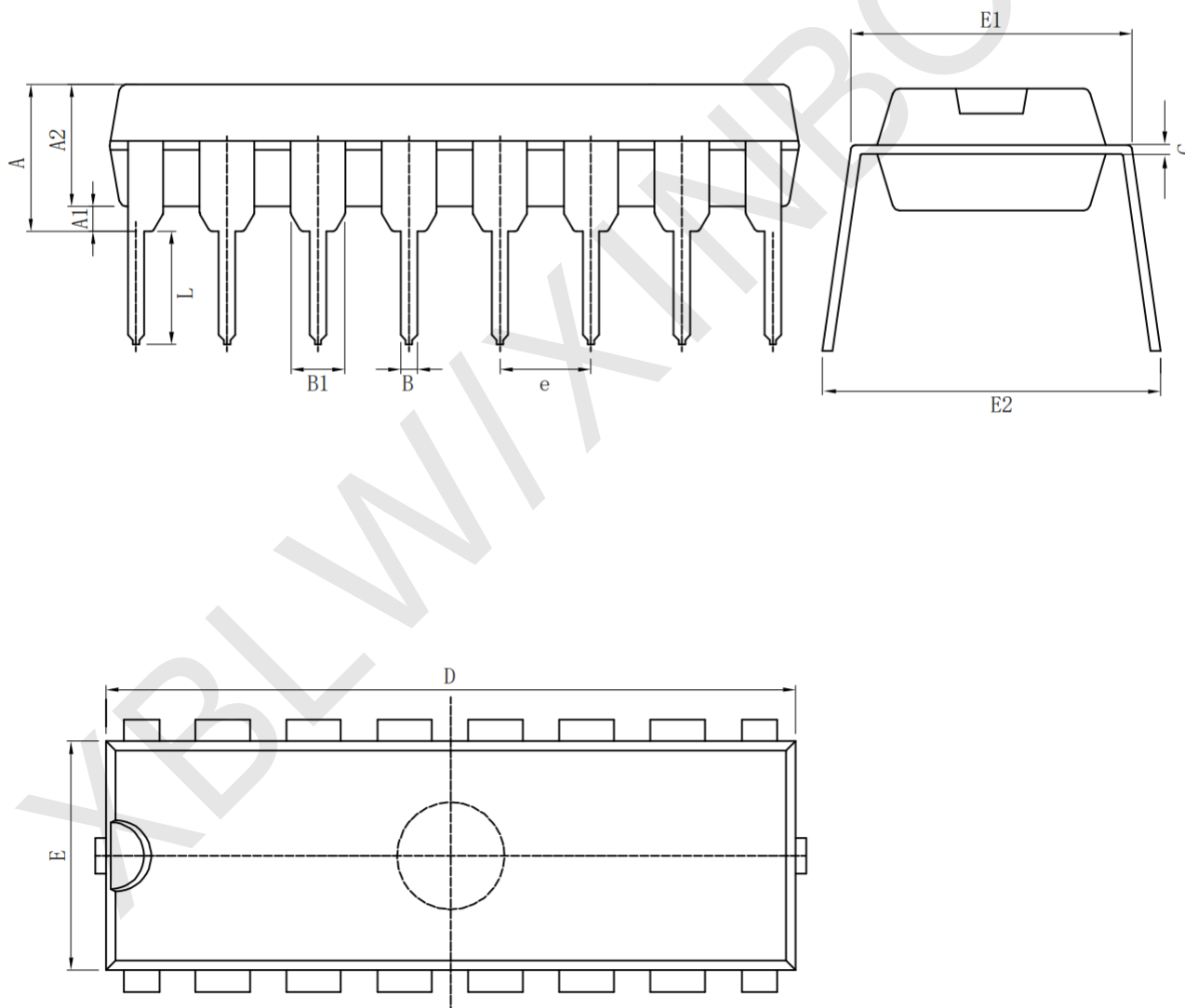
Test Data

Type	Input		Load	Test
	V_I	t_r, t_f	C_L	
SN74LS390	V_{CC}	6ns	15pF, 50pF	t_{PHL}, t_{PLH}

Package Information

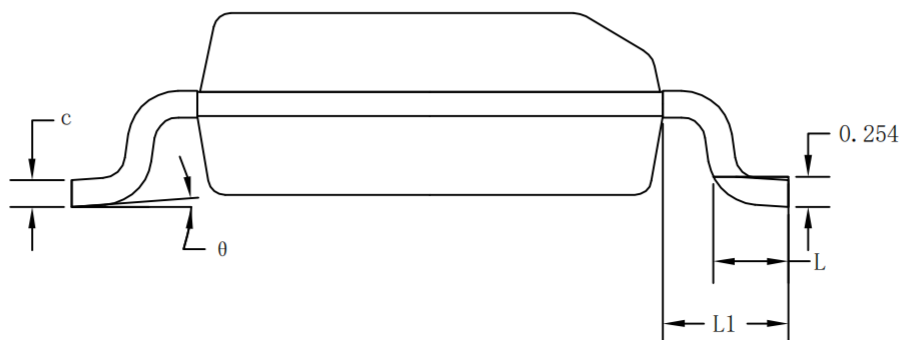
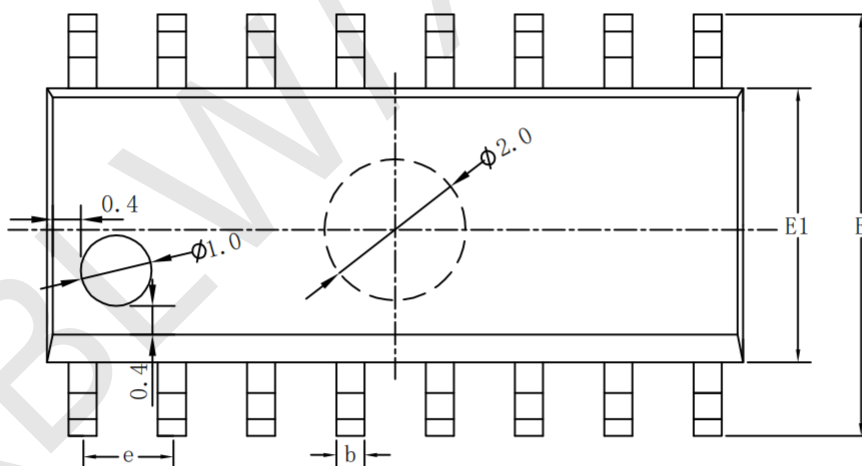
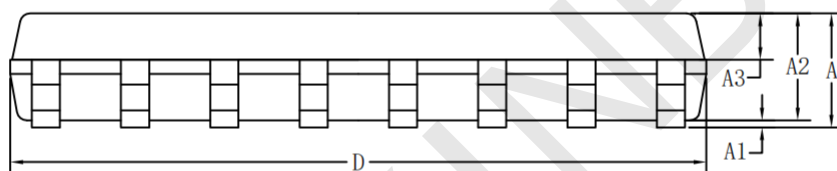
· DIP-16

Symbol	Dimensions In Millimeters		Symbol	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	18.80	19.20	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



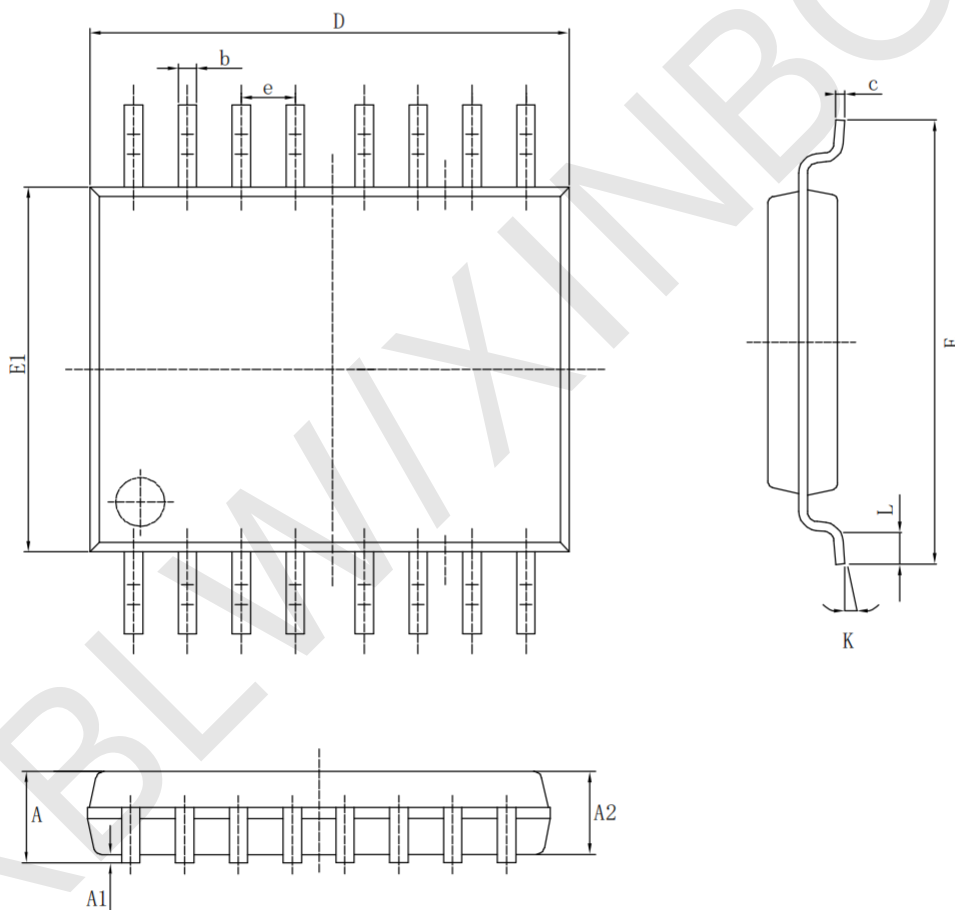
· SOP-16

Symbol	Size	Dimensions In Millimeters			Symbol	Size	Dimensions In Inches		
		Min(mm)	Nom(mm)	Max(mm)			Min(in)	Nom(in)	Max(in)
A		1.500	1.600	1.700	A		0.059	0.063	0.067
A1		0.100	0.150	0.250	A1		0.004	0.006	0.010
A2		1.400	1.450	1.500	A2		0.055	0.057	0.059
A3		0.600	0.650	0.700	A3		0.024	0.026	0.028
b		0.300	0.400	0.500	b		0.012	0.016	0.020
c		0.150	0.200	0.250	c		0.006	0.008	0.010
D		9.800	9.900	10.00	D		0.386	0.390	0.394
E		5.800	6.000	6.200	E		0.228	0.236	0.244
E1		3.850	3.900	3.950	E1		0.152	0.154	0.156
e		1.27 (BSC)			e		0.050 (BSC)		
L		0.500	0.600	0.700	L		0.020	0.024	0.028
L1		1.05 (BSC)			L1		0.041 (BSC)		
θ		0°	4°	8°	θ		0°	4°	8°



· TSSOP-16

Size Symbol	Dimensions In Millimeters		Size Symbol	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	4.480	E1	0.169	0.176
e	0.65 (BSC)		e	0.0256 (BSC)	
K	0°	8°	K	0°	8°
L	0.450	0.750	L	0.018	0.030



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