



CD4094

8-stage Shift-and-store Bus Register

Product Specification

Specification Revision History:

Version	Date	Description
2019-07-A1	2019-07	New
2021-12-A2	2021-12	Modify Ordering Information
2022-03-A3	2022-03	Modify ambient temperature to $-40^{\circ}\text{C}\sim+105^{\circ}\text{C}$ and add electrical characteristics of $-40^{\circ}\text{C}\sim+105^{\circ}\text{C}$



1、General Description

The CD4094 is an 8-stage serial shift register. It has a storage latch associated with each stage for strobing data from the serial input to parallel buffered 3-state outputs QP0 to QP7. The parallel outputs may be connected directly to common bus lines. Data is shifted on positive-going clock transitions. The data in each shift register stage is transferred to the storage register when the strobe (STR) input is HIGH. Data in the storage register appears at the outputs whenever the output enable (OE) signal is HIGH.

Two serial outputs (QS1 and QS2) are available for cascading a number of CD4094 devices. Serial data is available at QS1 on positive-going clock edges to allow high-speed operation in cascaded systems with a fast clock rise time. The same serial data is available at QS2 on the next negative going clock edge. This is used for cascading CD4094 devices when the clock has a slow rise time.

It operates over a recommended V_{DD} power supply range of 3V to 15V referenced to V_{SS} (usually ground). Unused inputs must be connected to V_{DD} , V_{SS} , or another input.

Features:

- Wide supply voltage range from 3V to 15V
- Fully static operation
- 5V, 10V, and 15V parametric ratings
- Standardized symmetrical output characteristics
- Specified from -40°C to +105°C
- Packaging information: DIP16/SOP16/TSSOP16

**Ordering Information:****Tube packing specifications:**

Part number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Notes
CD4094DA16.TB	DIP16	CD4094	25 PCS/tube	40 tube/box	1000 PCS/box	Dimensions of plastic enclosure: 19.0mm×6.4mm Pin spacing: 2.54mm
CD4094SA16.TB	SOP16	CD4094	50 PCS/tube	200 tube/box	10000 PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing: 1.27mm
CD4094TA16.TB	TSSOP16	CD4094	96 PCS/tube	200 tube/box	19200 PCS/box	Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing: 0.65mm

Reel packing specifications:

Part number	Packaging form	Marking code	Reel quantity	Boxed reel quantity	Notes
CD4094SA16.TR	SOP16	CD4094	4000 PCS/reel	8000 PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing:1.27mm
CD4094TA16.TR	TSSOP16	CD4094	5000 PCS/reel	10000 PCS/box	Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing:0.65mm

Note: If the physical information is inconsistent with the ordering information, please refer to the actual product.



2、Block Diagram And Pin Description

2.1、Block Diagram

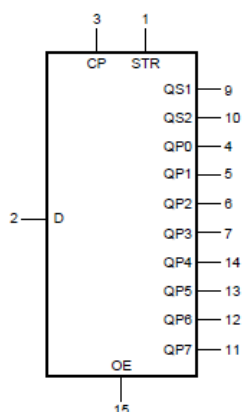


Figure 1. Logic symbol

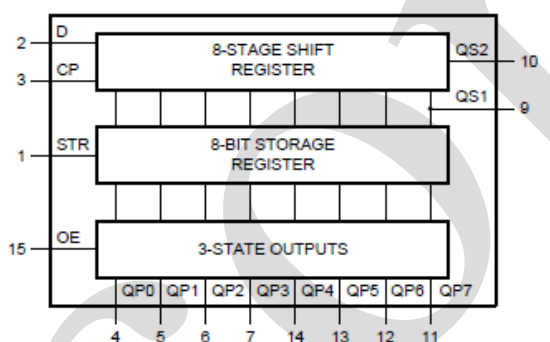


Figure 2. Functional diagram

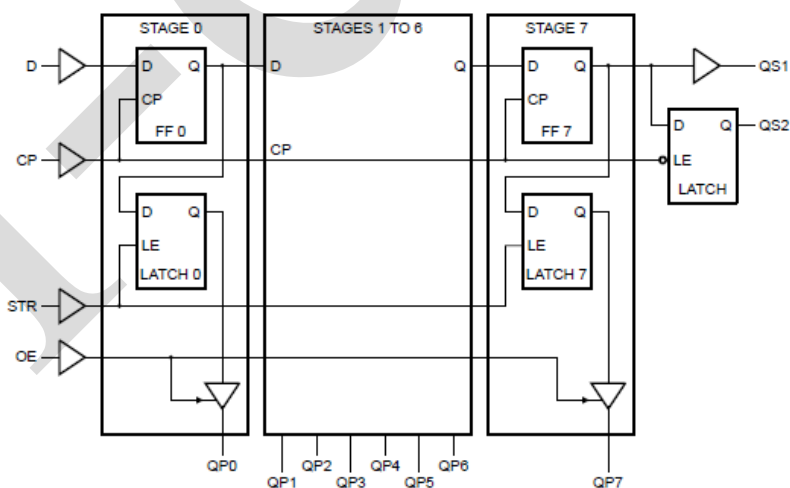


Figure 3. Logic diagram

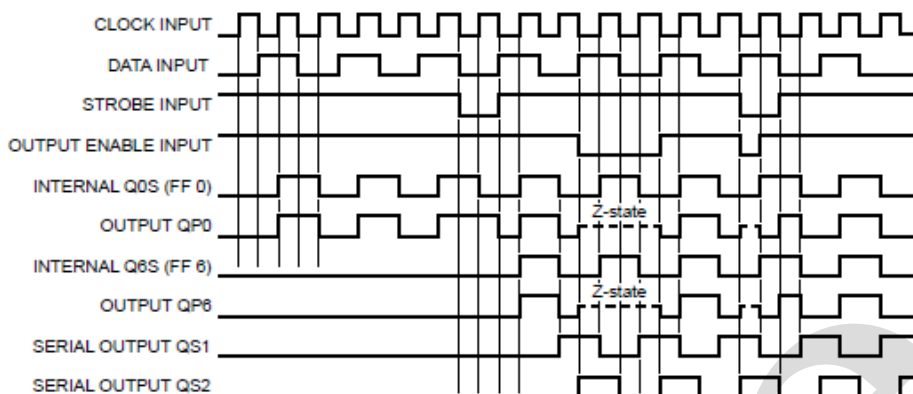
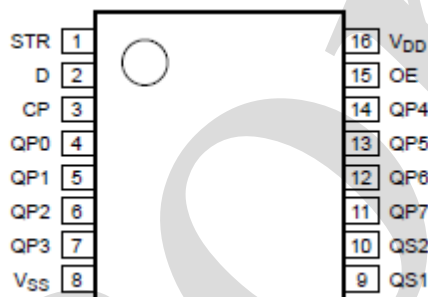


Figure 4. Timing diagram

2.2、Pin Configurations



2.3、Pin Description

Pin No.	Pin Name	Description
1	STR	strobe input
2	D	data input
3	CP	clock input
4	QP0	parallel output
5	QP1	parallel output
6	QP2	parallel output
7	QP3	parallel output
8	V _{SS}	ground (0V)
9	QS1	serial output
10	QS2	serial output
11	QP7	parallel output
12	QP6	parallel output
13	QP5	parallel output
14	QP4	parallel output
15	OE	output enable input
16	V _{DD}	supply voltage

**2.4、Function Table**

Input				Parallel output		Serial output	
CP	OE	STR	D	QP0	QPn	QS1	QS2
↑	L	X	X	Z	Z	Q6S	NC
↓	L	X	X	Z	Z	NC	Q7S
↑	H	L	X	NC	NC	Q6S	NC
↑	H	H	L	L	QPn-1	Q6S	NC
↑	H	H	H	H	QPn-1	Q6S	NC
↓	H	H	H	NC	NC	NC	Q7S

Note: H=HIGH voltage level; L=LOW voltage level; X=don't care; Z=HIGH-impedance OFF-state;

NC=no change; ↑=positive-going transition; ↓=negative-going transition;

Q6S=the data in register stage 6 before the LOW to HIGH clock transition;

Q7S=the data in register stage 7 before the HIGH to LOW clock transition.

3、Electrical Parameter**3.1、Absolute Maximum Ratings**

(Voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Max.	Unit
supply voltage	V_{DD}	-	-0.5	+18	V
DC input current	I_{IK}	any one input	-	±10	mA
input voltage	V_I	all inputs	-0.5	$V_{DD}+0.5$	V
storage temperature	T_{stg}	-	-65	+150	°C
total power dissipation	P_{tot}	-	-	500	mW
device dissipation	P	per output transistor	-	100	mW
Soldering temperature	T_L	10s	DIP	245	°C
			SOP	250	°C

Note:

[1] For DIP16 packages: above 70°C the value of P_{tot} derates linearly with 12mW/K.

[2] For SOP16 packages: above 70°C the value of P_{tot} derates linearly with 8mW/K.

[3] For (T)SSOP16 packages: above 60°C the value of P_{tot} derates linearly with 5.5mW/K.

**3.2、Recommended Operating Conditions**

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
supply voltage	V_{DD}	-	3	-	15	V
ambient temperature	T_{amb}	in free air	-40	-	+105	°C
data setup time	t_{su}	$V_{DD}=5V$	125	-	-	ns
		$V_{DD}=10V$	55	-	-	ns
		$V_{DD}=15V$	35	-	-	ns
clock pulse width	t_w	$V_{DD}=5V$	200	-	-	ns
		$V_{DD}=10V$	100	-	-	ns
		$V_{DD}=15V$	83	-	-	ns
clock input frequency	f_{max}	$V_{DD}=5V$	dc	-	1.25	MHz
		$V_{DD}=10V$		-	2.5	MHz
		$V_{DD}=15V$		-	3	MHz
clock rise and fall time	t_{rCL}, t_{fCL}	$V_{DD}=5V$	-	-	15	us
		$V_{DD}=10V$	-	-	5	us
		$V_{DD}=15V$	-	-	5	us
strobe setup time	t_w	$V_{DD}=5V$	200	-	-	ns
		$V_{DD}=10V$	80	-	-	ns
		$V_{DD}=15V$	70	-	-	ns

3.3、Electrical Characteristics**3.3.1、DC Characteristics 1**(T_{amb}=25°C, voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			T _{amb} =25°C			Unit
		V _O	V _{IN}	V _{DD}	Min.	Typ.	Max.	
supply current	I_{DD}	-	0, 5	5	-	0.04	5	uA
		-	0, 10	10	-	0.04	10	uA
		-	0, 15	15	-	0.04	20	uA
LOW-level output current	I_{OL}	0.4	0, 5	5	0.51	1	-	mA
		0.5	0, 10	10	1.3	2.6	-	mA
		1.5	0, 15	15	3.4	6.8	-	mA
HIGH-level output current	I_{OH}	4.6	0, 5	5	-0.51	-1	-	mA
		2.5	0, 5	5	-1.6	-3.2	-	mA
		9.5	0, 10	10	-1.3	-2.6	-	mA
		13.5	0, 15	15	-3.4	-6.8	-	mA
LOW-level output voltage	V_{OL}	-	0, 5	5	-	0	0.05	V
		-	0, 10	10	-	0	0.05	V
		-	0, 15	15	-	0	0.05	V
HIGH-level output voltage	V_{OH}	-	0, 5	5	4.95	5	-	V
		-	0, 10	10	9.95	10	-	V
		-	0, 15	15	14.95	15	-	V
LOW-level input voltage	V_{IL}	0.5, 4.5	-	5	-	-	1.5	V
		1, 9	-	10	-	-	3	V
		1.5, 13.5	-	15	-	-	4	V



HIGH-level input voltage	V_{IH}	0.5, 4.5	-	5	3.5	-	-	V
		1, 9	-	10	7	-	-	V
		1.5, 13.5	-	15	11	-	-	V
input leakage current	I_I	-	0, 15	15	-	$\pm 10^{-5}$	± 0.1	μA
OFF-state output current	I_{OZ}	0, 15	0, 15	15	-	$\pm 10^{-4}$	± 0.4	μA

3.3.2、DC Characteristics 2(T_{amb}=-40°C to +85°C, voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			T _{amb} =-40°C		T _{amb} =+85°C		Unit
		V _O	V _{IN}	V _{DD}	Min.	Max.	Min.	Max.	
supply current	I_{DD}	-	0, 5	5	-	5	-	150	μA
		-	0, 10	10	-	10	-	300	μA
		-	0, 15	15	-	20	-	600	μA
LOW-level output current	I_{OL}	0.4	0, 5	5	0.61	-	0.42	-	mA
		0.5	0, 10	10	1.5	-	1.1	-	mA
		1.5	0, 15	15	4	-	2.8	-	mA
HIGH-level output current	I_{OH}	4.6	0, 5	5	-0.61	-	-0.42	-	mA
		2.5	0, 5	5	-1.8	-	-1.3	-	mA
		9.5	0, 10	10	-1.5	-	-1.1	-	mA
		13.5	0, 15	15	-4	-	-2.8	-	mA
LOW-level output voltage	V_{OL}	-	0, 5	5	-	0.05	-	0.05	V
		-	0, 10	10	-	0.05	-	0.05	V
		-	0, 15	15	-	0.05	-	0.05	V
HIGH-level output voltage	V_{OH}	-	0, 5	5	4.95	-	4.95	-	V
		-	0, 10	10	9.95	-	9.95	-	V
		-	0, 15	15	14.95	-	14.95	-	V
LOW-level input voltage	V_{IL}	0.5, 4.5	-	5	-	1.5	-	1.5	V
		1, 9	-	10	-	3	-	3	V
		1.5, 13.5	-	15	-	4	-	4	V
HIGH-level input voltage	V_{IH}	0.5, 4.5	-	5	3.5	-	3.5	-	V
		1, 9	-	10	7	-	7	-	V
		1.5, 13.5	-	15	11	-	11	-	V
input leakage current	I_I	-	0, 15	15	-	± 0.1	-	± 1	μA
OFF-state output current	I_{OZ}	0, 15	0, 15	15	-	± 0.4	-	± 12	μA



3.3.3、DC Characteristics 3

($T_{amb}=-40^{\circ}\text{C}$ to $+105^{\circ}\text{C}$, voltages are referenced to V_{SS} (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions (V)			$T_{amb}=-40^{\circ}\text{C}$		$T_{amb}=+105^{\circ}\text{C}$		Unit
		V_O	V_{IN}	V_{DD}	Min.	Max.	Min.	Max.	
supply current	I_{DD}	-	0, 5	5	-	5	-	150	μA
		-	0, 10	10	-	10	-	300	μA
		-	0, 15	15	-	20	-	600	μA
LOW-level output current	I_{OL}	0.4	0, 5	5	0.61	-	0.36	-	mA
		0.5	0, 10	10	1.5	-	0.9	-	mA
		1.5	0, 15	15	4	-	2.4	-	mA
HIGH-level output current	I_{OH}	4.6	0, 5	5	-0.61	-	-0.36	-	mA
		2.5	0, 5	5	-1.8	-	-1.15	-	mA
		9.5	0, 10	10	-1.5	-	-0.9	-	mA
		13.5	0, 15	15	-4	-	-2.4	-	mA
LOW-level output voltage	V_{OL}	-	0, 5	5	-	0.05	-	0.05	V
		-	0, 10	10	-	0.05	-	0.05	V
		-	0, 15	15	-	0.05	-	0.05	V
HIGH-level output voltage	V_{OH}	-	0, 5	5	4.95	-	4.95	-	V
		-	0, 10	10	9.95	-	9.95	-	V
		-	0, 15	15	14.95	-	14.95	-	V
LOW-level input voltage	V_{IL}	0.5, 4.5	-	5	-	1.5	-	1.5	V
		1, 9	-	10	-	3	-	3	V
		1.5, 13.5	-	15	-	4	-	4	V
HIGH-level input voltage	V_{IH}	0.5, 4.5	-	5	3.5	-	3.5	-	V
		1, 9	-	10	7	-	7	-	V
		1.5, 13.5	-	15	11	-	11	-	V
input leakage current	I_I	-	0, 15	15	-	± 0.1	-	± 1	μA
OFF-state output current	I_{OZ}	0, 15	0, 15	15	-	± 0.4	-	± 12	μA

**3.3.4、AC Characteristics**(T_{amb}=25°C, V_{SS}=0V, t_r, t_f=20ns, C_L=50pF, R_L=200kΩ, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
propagation delay time	t _{PHL} , t _{PLH}	CP to QS1; see Figure 6	V _{DD} =5V	-	300	600 ns
			V _{DD} =10V	-	125	250 ns
			V _{DD} =15V	-	95	190 ns
		CP to QS2; see Figure 6	V _{DD} =5V	-	230	460 ns
			V _{DD} =10V	-	110	220 ns
			V _{DD} =15V	-	75	150 ns
		CP to QPn; see Figure 6	V _{DD} =5V	-	420	840 ns
			V _{DD} =10V	-	195	390 ns
			V _{DD} =15V	-	135	270 ns
		STR to QPn; see Figure 7	V _{DD} =5V	-	290	580 ns
			V _{DD} =10V	-	145	290 ns
			V _{DD} =15V	-	100	200 ns
HIGH to OFF-state/OFF-state to HIGH propagation delay	t _{PHZ} , t _{PZH}	OE to QPn; see Figure 8	V _{DD} =5V	-	140	280 ns
			V _{DD} =10V	-	60	120 ns
			V _{DD} =15V	-	45	90 ns
LOW to OFF-state/OFF-state to LOW propagation delay	t _{PLZ} , t _{PZL}	OE to QPn; see Figure 8	V _{DD} =5V	-	100	200 ns
			V _{DD} =10V	-	50	100 ns
			V _{DD} =15V	-	40	80 ns
pulse width	t _w	minimum HIGH strobe pulse; see Figure 7	V _{DD} =5V	-	100	200 ns
			V _{DD} =10V	-	40	80 ns
			V _{DD} =15V	-	35	70 ns
		minimum LOW clock pulse; see Figure 6	V _{DD} =5V	-	100	200 ns
			V _{DD} =10V	-	50	100 ns
			V _{DD} =15V	-	40	83 ns
data setup time	t _{su}	D to CP; see Figure 9	V _{DD} =5V	-	60	125 ns
			V _{DD} =10V	-	30	55 ns
			V _{DD} =15V	-	20	35 ns
transition time	t _t	-	V _{DD} =5V	-	100	200 ns
			V _{DD} =10V	-	50	100 ns
			V _{DD} =15V	-	40	80 ns
clock input rise and fall time	t _{rCL} , t _{fCL}	-	V _{DD} =5V	15	-	us
			V _{DD} =10V	5	-	us
			V _{DD} =15V	5	-	us
maximum clock frequency	f _{max}	see Figure 6	V _{DD} =5V	1.25	2.5	MHz
			V _{DD} =10V	2.5	5	MHz
			V _{DD} =15V	3	6	MHz
input capacitance	C _I	any input	-	5	7.5	pF

Note: t_t is the same as t_{TLH} and t_{THL}.



4、Testing Circuit

4.1、AC Testing Circuit

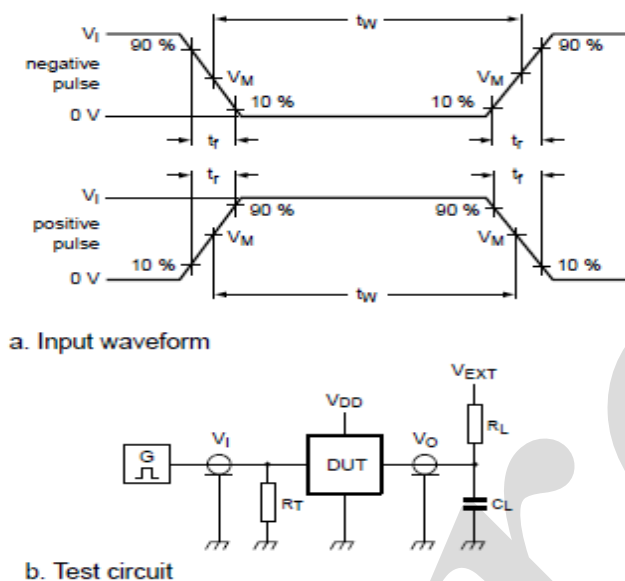


Figure 5. Test circuit for switching times

Definitions for test circuit:

DUT=Device Under Test.

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.

R_L =Load resistance.

V_{EXT} =External voltage for measuring switching times.

4.2、AC Testing Waveforms

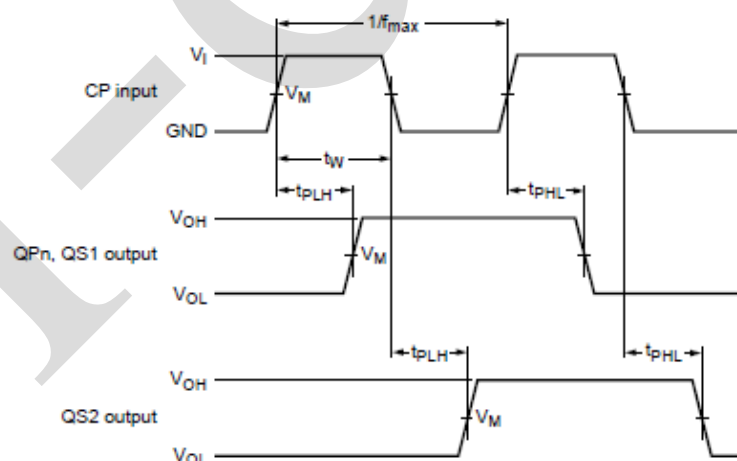


Figure 6. Clock to outputs propagation delays, and clock pulse width and maximum frequency

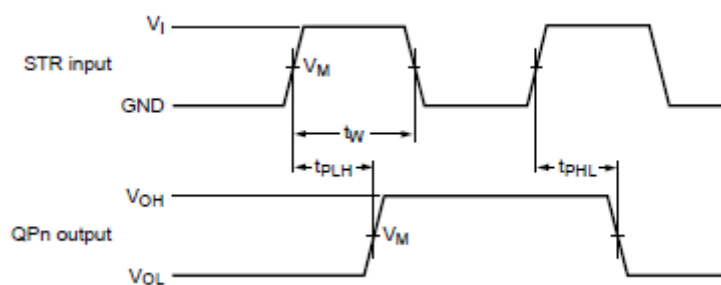


Figure 7. Strobe to output propagation delays, and strobe pulse width, set up and hold times

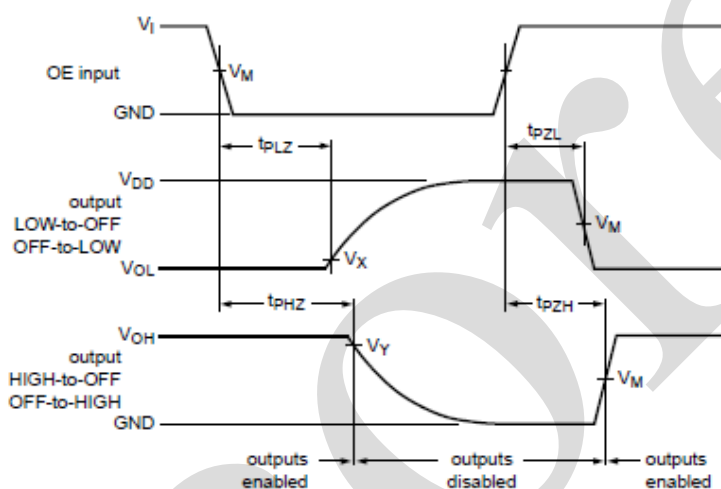


Figure 8. 3-state output enable and disable times for OE input

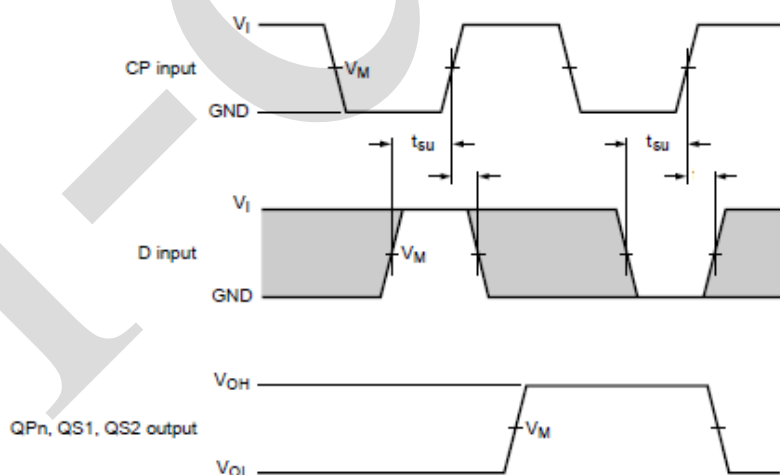


Figure 9. Data input data set up and hold times



4.3、Measurement Points

Supply voltage	Input	Output		
V_{DD}	V_M	V_M	V_X	V_Y
5V to 15V	$0.5 \times V_{DD}$	$0.5 \times V_{DD}$	$0.1 \times V_{DD}$	$0.9 \times V_{DD}$

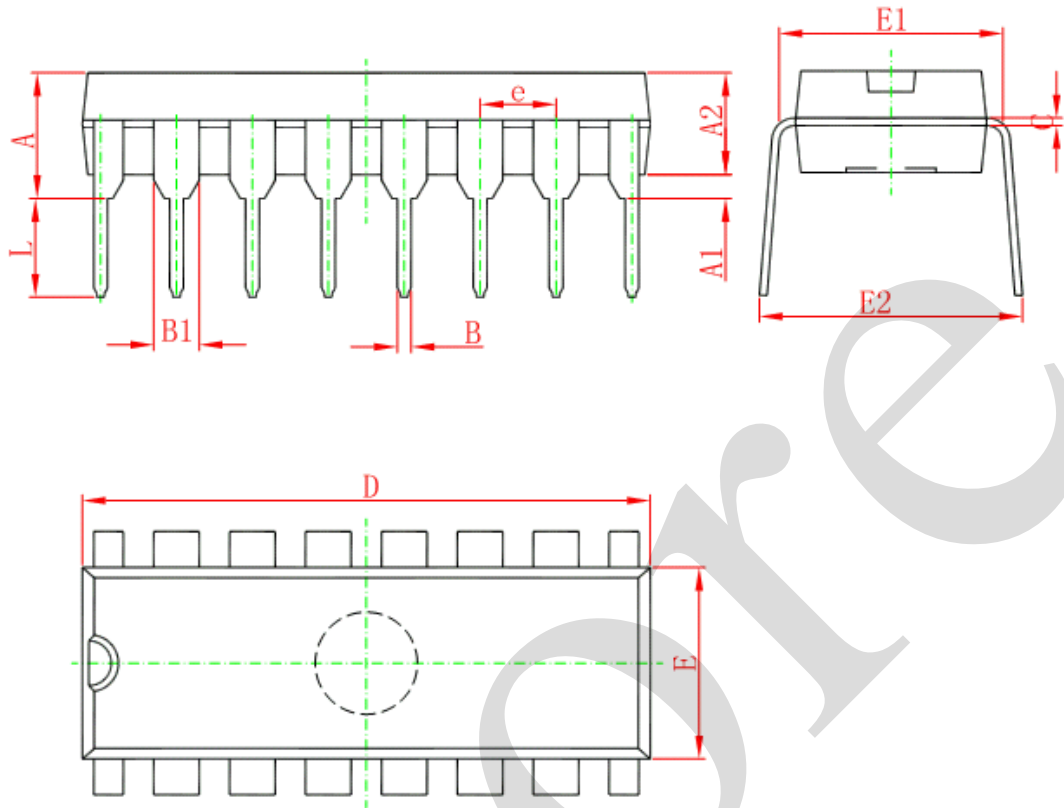
4.4、Test Data

Supply voltage	Input		Load		V_{EXT}		
V_{DD}	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PHZ}, t_{PZH}	t_{PLZ}, t_{PZL}
5V to 15V	V_{SS} or V_{DD}	$\leq 20ns$	50pF	1k Ω	open	V_{SS}	V_{DD}



5、Package Information

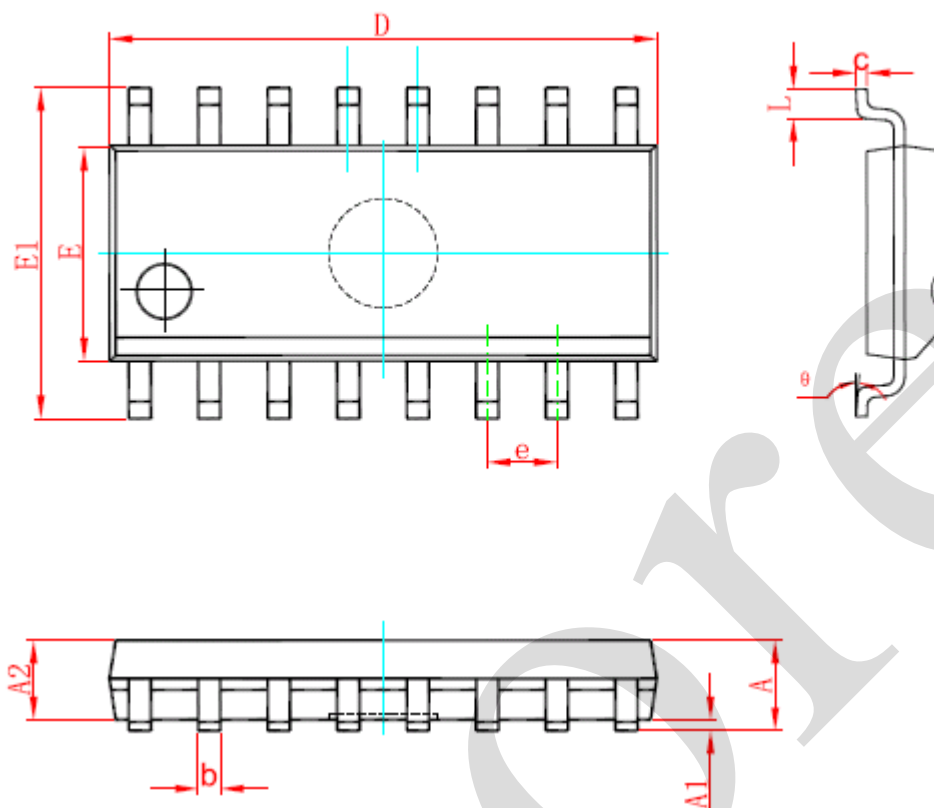
5.1、DIP16



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



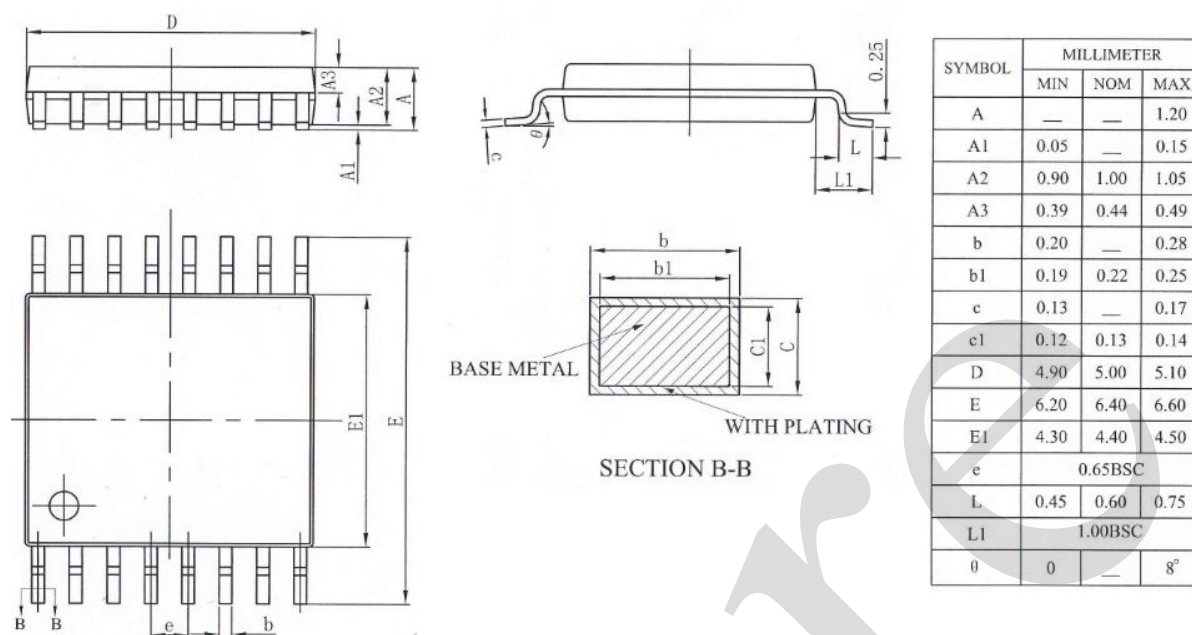
5.2、SOP16



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	0.170	0.250	0.007	0.010
D	9.800	10.200	0.386	0.402
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°



5.3、TSSOP16





6、Statements And Notes

6.1、The name and content of Hazardous substances or Elements in the product

Part name	Hazardous substances or Elements									
	Lead and lead compounds	Mercury and mercury compounds	Cadmium and cadmium compounds	Hexavalent chromium compounds	Polybrominated biphenyls	Polybrominated biphenyl ethers	Dibutyl phthalate	Butylbenzyl phthalate	Di-2-ethylhexyl phthalate	Diisobutyl phthalate
Lead frame	○	○	○	○	○	○	○	○	○	○
Plastic resin	○	○	○	○	○	○	○	○	○	○
Chip	○	○	○	○	○	○	○	○	○	○
The lead	○	○	○	○	○	○	○	○	○	○
Plastic sheet installed	○	○	○	○	○	○	○	○	○	○
explanation	<p>○: Indicates that the content of hazardous substances or elements in the detection limit of the following the SJ/T11363-2006 standard.</p> <p>×: Indicates that the content of hazardous substances or elements exceeding the SJ/T11363-2006 Standard limit requirements.</p>									

6.2、Notion

Recommended carefully reading this information before the use of this product;

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