



# CD4020 14-stage Binary Counter

## Product Specification

**Specification Revision History:**

Version	Date	Description
2023-06-A1	2023-06	New



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## 1、General Description

The CD4020 is a 14-stage binary counter with a clock input ( $\overline{CP}$ ), an overriding asynchronous master reset input (MR) and twelve fully buffered outputs (Q0, and Q3 to Q13).

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:

- Supply voltage range:3V to 15V
- Temperature range:-40°C to +125°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
CD4020DA16.TB	DIP16	CD4020	25 PCS/tube	40 tube/box	1000 PCS/box	Dimensions of plastic enclosure: 19.0mm×6.4mm Pin spacing:2.54mm
CD4020SA16.TB	SOP16	CD4020	50 PCS/tube	200 tube/box	10000 PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing:1.27mm
CD4020TA16.TB	TSSOP16	CD4020	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
CD4020SA16.TR	SOP16	CD4020	4000PCS/reel	8000PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing:1.27mm
CD4020TA16.TR	TSSOP16	CD4020	5000PCS/reel	10000PCS/box	Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing:0.65mm

Note 1: “XX” refers to variable content, meaning year and package batch serial number.

Note 2: 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

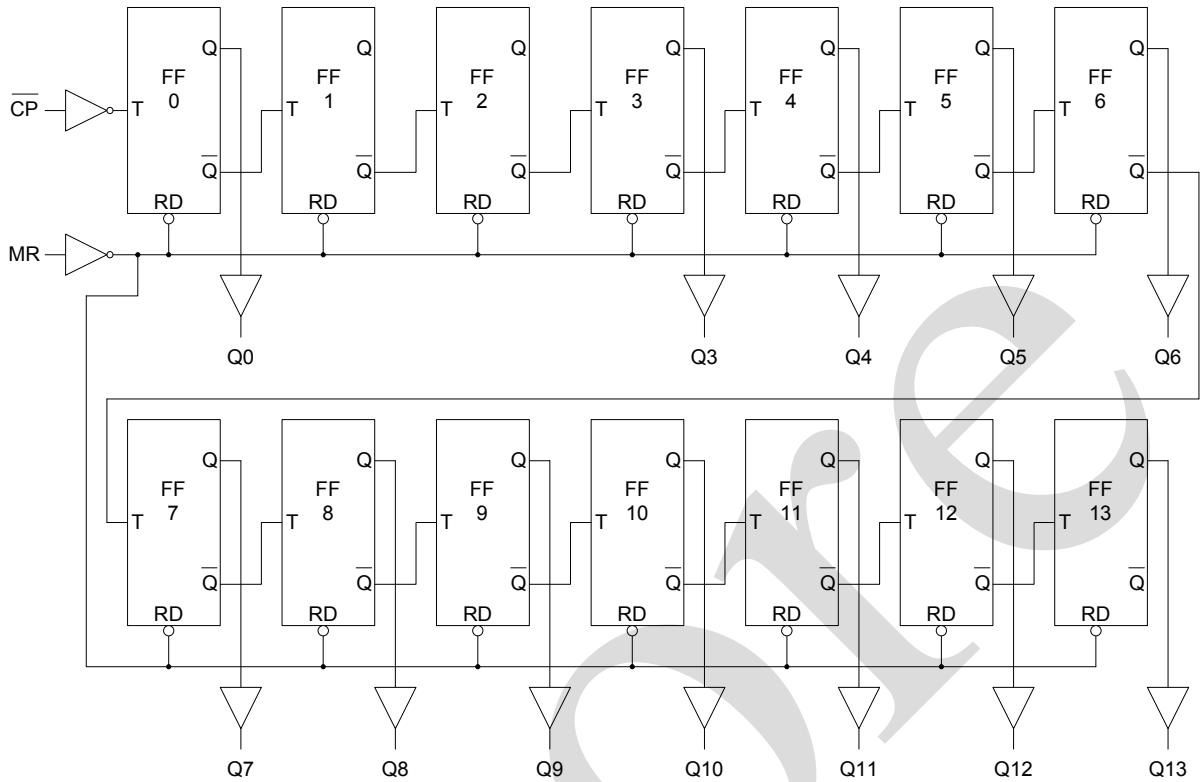
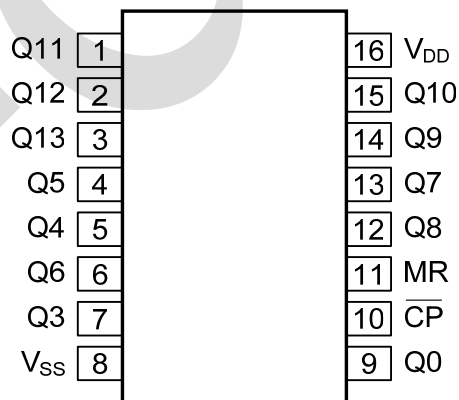


Figure 1. Logic diagram

### 2.2、Pin Configurations



### 2.3、Pin Description

Pin No.	Pin Name	Description
1	Q11	parallel output
2	Q12	parallel output
3	Q13	parallel output
4	Q5	parallel output



5	Q4	parallel output
6	Q6	parallel output
7	Q3	parallel output
8	V <sub>SS</sub>	ground supply voltage
9	Q0	parallel output
10	$\overline{CP}$	clock input (HIGH-to-LOW edge triggered)
11	MR	master reset input (active HIGH)
12	Q8	parallel output
13	Q7	parallel output
14	Q9	parallel output
15	Q10	parallel output
16	V <sub>DD</sub>	supply voltage

## 2.4、Function Table

Input		Output
$\overline{CP}$	MR	Q0, Q3 to Q13
↑	L	no change
↓	L	Count
X	H	L

Note:

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

↑=positive-going transition; ↓=negative-going 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
input voltage	$V_I$	all inputs	-0.5	$V_{DD}+0.5$	V
DC input current	$I_{IK}$	any one input	-	$\pm 10$	mA
storage temperature	$T_{stg}$	-	-65	+150	$^{\circ}C$
soldering temperature	$T_L$	10s	DIP	245	$^{\circ}C$
			SOP/SSOP	260	

### 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	-	+125	$^{\circ}C$

### 3.3、Electrical Characteristics

#### 3.3.1、DC Characteristics 1

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

Parameter	Symbol	$V_{DD}$	Conditions	Min.	Typ.	Max.	Unit
HIGH-level input voltage	$V_{IH}$	5V	-	3.5	-	-	V
		10V	-	7	-	-	V
		15V	-	11	-	-	V
LOW-level input voltage	$V_{IL}$	5V	-	-	-	1.5	V
		10V	-	-	-	3	V
		15V	-	-	-	4	V
HIGH-level output voltage	$V_{OH}$	5V	$ I_O <1\mu A$	4.95	-	-	V
		10V	$ I_O <1\mu A$	9.95	-	-	V
		15V	$ I_O <1\mu A$	14.95	-	-	V
LOW-level output voltage	$V_{OL}$	5V	$ I_O <1\mu A$	-	-	0.05	V
		10V	$ I_O <1\mu A$	-	-	0.05	V
		15V	$ I_O <1\mu A$	-	-	0.05	V
HIGH-level output current	$I_{OH}$	5V	$V_O=4.6V$	-	-	-0.34	mA
		5V	$V_O=2.5V$	-	-	-1.3	mA
		10V	$V_O=9.5V$	-	-	-0.55	mA
		15V	$V_O=13.5V$	-	-	-1.65	mA
LOW-level output current	$I_{OL}$	5V	$V_O=0.4V$	0.34	-	-	mA
		10V	$V_O=0.5V$	0.46	-	-	mA
		15V	$V_O=1.5V$	1.4	-	-	mA
input leakage current	$I_I$	15V	$V_I=15V$ or GND	-	-	$\pm 1$	$\mu A$
supply current	$I_{DD}$	5V	$V_I=5V$ or GND; $I_O=0A$	-	-	150	$\mu A$
		10V	$V_I=10V$ or GND; $I_O=0A$	-	-	300	$\mu A$
		15V	$V_I=15V$ or GND; $I_O=0A$	-	-	600	$\mu A$



## 3.3.2、DC Characteristics 2

( $T_{amb}=-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{SS}=0\text{V}$ , unless otherwise specified.)

Parameter	Symbol	V <sub>DD</sub>	Conditions	Min.	Typ.	Max.	Unit
HIGH-level input voltage	V <sub>IH</sub>	5V	-	3.5	-	-	V
		10V	-	7	-	-	V
		15V	-	11	-	-	V
LOW-level input voltage	V <sub>IL</sub>	5V	-	-	-	1.5	V
		10V	-	-	-	3	V
		15V	-	-	-	4	V
HIGH-level output voltage	V <sub>OH</sub>	5V	I <sub>O</sub>  <1uA	4.95	-	-	V
		10V	I <sub>O</sub>  <1uA	9.95	-	-	V
		15V	I <sub>O</sub>  <1uA	14.95	-	-	V
LOW-level output voltage	V <sub>OL</sub>	5V	I <sub>O</sub>  <1uA	-	-	0.05	V
		10V	I <sub>O</sub>  <1uA	-	-	0.05	V
		15V	I <sub>O</sub>  <1uA	-	-	0.05	V
HIGH-level output current	I <sub>OH</sub>	5V	V <sub>O</sub> =4.6V	-	-	-0.3	mA
		5V	V <sub>O</sub> =2.5V	-	-	-1.15	mA
		10V	V <sub>O</sub> =9.5V	-	-	-0.45	mA
		15V	V <sub>O</sub> =13.5V	-	-	-1.4	mA
LOW-level output current	I <sub>OL</sub>	5V	V <sub>O</sub> =0.4V	0.29	-	-	mA
		10V	V <sub>O</sub> =0.5V	0.38	-	-	mA
		15V	V <sub>O</sub> =1.5V	1.2	-	-	mA
input leakage current	I <sub>I</sub>	15V	V <sub>I</sub> =15V or GND	-	-	±1	uA
supply current	I <sub>DD</sub>	5V	V <sub>I</sub> =5V or GND;I <sub>O</sub> =0A	-	-	150	uA
		10V	V <sub>I</sub> =10V or GND;I <sub>O</sub> =0A	-	-	300	uA
		15V	V <sub>I</sub> =15V or GND;I <sub>O</sub> =0A	-	-	600	uA



### 3.3.3、AC Characteristics 1

( $T_{amb}=-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{SS}=0\text{V}$ , unless otherwise specified.)

Parameter	Symbol	$V_{DD}$	Conditions	Min.	Typ.	Max.	Unit		
HIGH to LOW propagation delay	$t_{PHL}$	5	$\overline{CP}$ to Q0; see Figure 4	-	105	210	ns		
		10		-	45	90	ns		
		15		-	30	65	ns		
				5	Qn to Qn+1	-	80	160	ns
				10		-	30	60	ns
				15		-	20	40	ns
				5	MR to Qn; see Figure 4	-	180	360	ns
				10		-	90	180	ns
				15		-	70	140	ns
LOW to HIGH propagation delay	$t_{PLH}$	5	$\overline{CP}$ to Q0; see Figure 4	-	105	210	ns		
		10		-	50	95	ns		
		15		-	35	70	ns		
				5	Qn to Qn+1	-	70	140	ns
				10		-	25	50	ns
				15		-	20	40	ns
transition time	$t_t$	5	see Figure 4	-	60	120	ns		
		10		-	30	60	ns		
		15		-	20	40	ns		
pulse width	$t_w$	5	$\overline{CP}=\text{HIGH}$ ; minimum width; see Figure 4	50	25	-	ns		
		10		25	15	-	ns		
		15		20	10	-	ns		
				5	MR=HIGH; minimum width; see Figure 4	130	65	-	ns
				10		95	50	-	ns
				15		90	45	-	ns
recovery time	$t_{rec}$	5	MR input; see Figure 4	115	60	-	ns		
		10		65	35	-	ns		
		15		55	25	-	ns		
maximum frequency	$f_{max}$	5	see Figure 4	5	10	-	MHz		
		10		13	25	-	MHz		
		15		18	35	-	MHz		

### 3.3.4、AC Characteristics 2

( $T_{amb}=-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $V_{SS}=0\text{V}$ , unless otherwise specified.)

Parameter	Symbol	$V_{DD}$	Conditions	Min.	Typ.	Max.	Unit		
HIGH to LOW propagation delay	$t_{PHL}$	5	$\overline{CP}$ to Q0; see Figure 4	-	-	252	ns		
		10		-	-	108	ns		
		15		-	-	78	ns		
				5	Qn to Qn+1	-	-	192	ns
				10		-	-	72	ns
				15		-	-	48	ns
				5	MR to Qn; see Figure 4	-	-	432	ns
				10		-	-	216	ns
				15		-	-	168	ns





LOW to HIGH propagation delay	$t_{PLH}$	5	$\overline{CP}$ to Q0; see Figure 4	-	-	252	ns
		10		-	-	114	ns
		15		-	-	84	ns
		5	Qn to Qn+1	-	-	168	ns
		10		-	-	60	ns
		15		-	-	48	ns
transition time	$t_t$	5	see Figure 4	-	-	144	ns
		10		-	-	72	ns
		15		-	-	48	ns
pulse width	$t_w$	5	$\overline{CP}$ =HIGH; minimum width; see Figure 4	60	-	-	ns
		10		30	-	-	ns
		15		24	-	-	ns
		5	MR=HIGH; minimum width; see Figure 4	156	-	-	ns
		10		114	-	-	ns
		15		108	-	-	ns
recovery time	$t_{rec}$	5	MR input; see Figure 4	138	-	-	ns
		10		78	-	-	ns
		15		66	-	-	ns
maximum frequency	$f_{max}$	5	see Figure 4	4.2	-	-	MHz
		10		10.8	-	-	MHz
		15		15	-	-	MHz

#### 4、Testing Circuit

##### 4.1、AC Testing Circuit

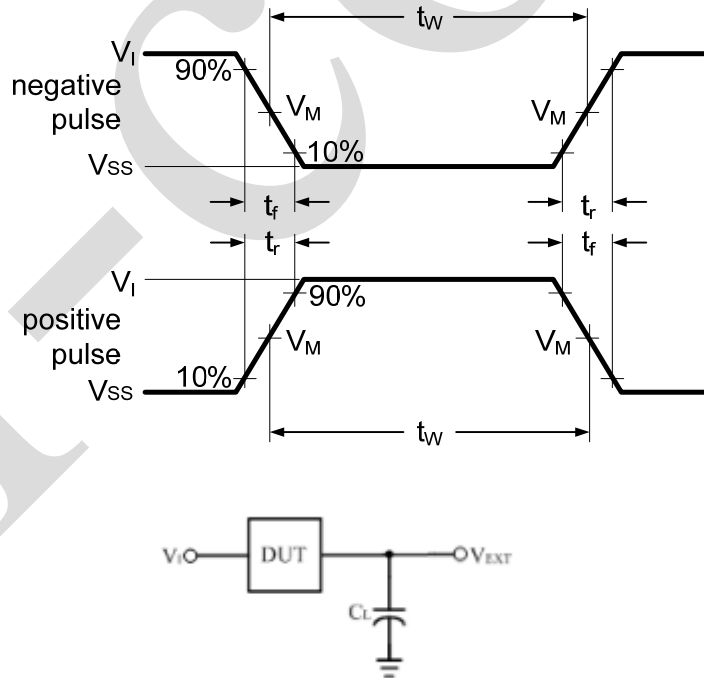


Figure 3. Load circuit

$C_L$  includes probe and jig capacitance.



## 4.2、 Test Data

Supply voltage	Input		Load	$V_{EXT}$		
$V_{DD}$	$V_I$	$t_r = t_f$	$C_L$	$t_{PLH}/t_{PHL}$	$t_{PLZ}/t_{PZL}$	$t_{PHZ}/t_{PZH}$
5V to 15V	$V_{CC}$	$\leq 20\text{ns}$	50pF	Open	$V_{DD}$	$V_{SS}$

## 4.3、 AC Testing Waveforms

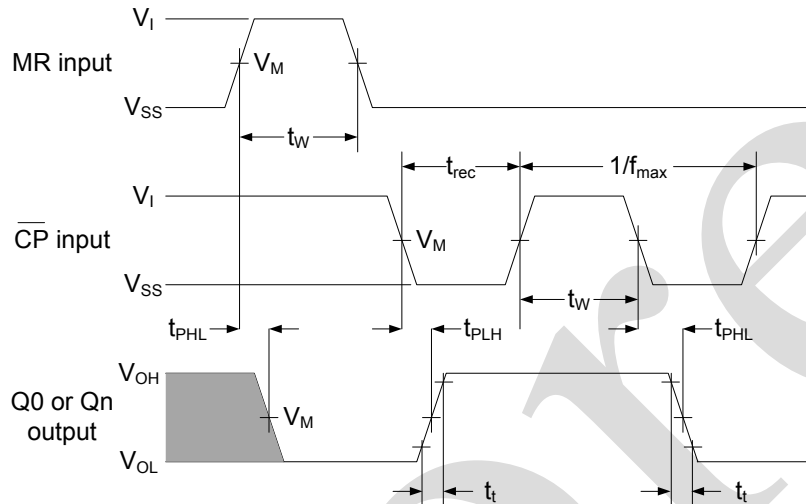


Figure 4. Propagation delays, minimum pulse widths, transition and recovery times and maximum clock frequency

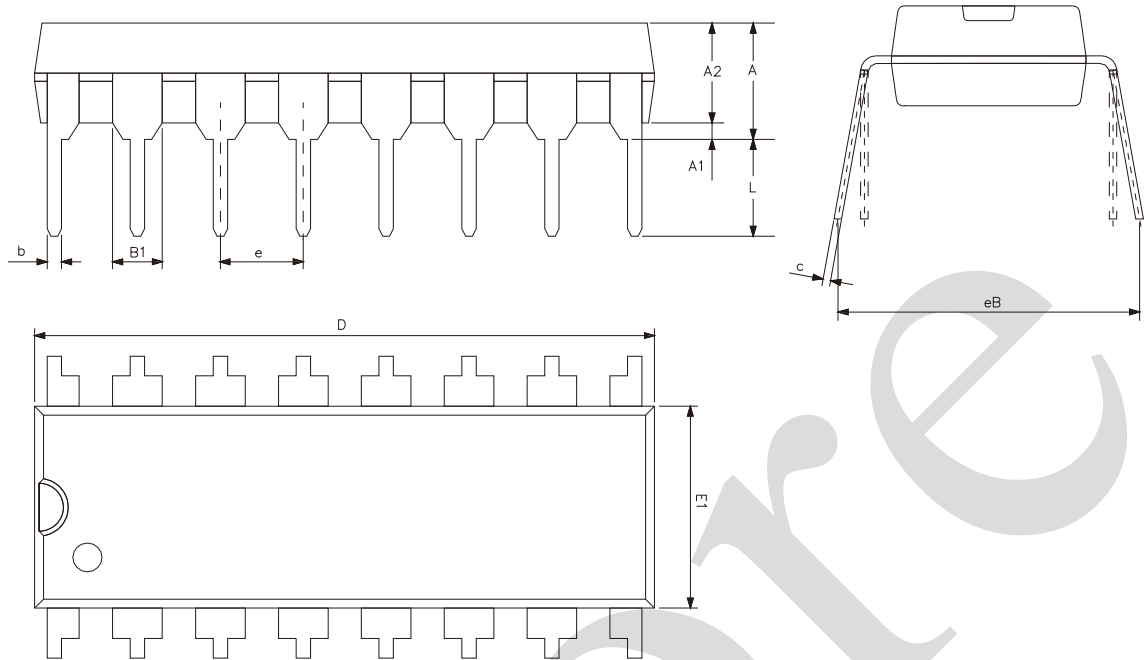
## 4.4、 Measurement Points

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



## 5、Package Information

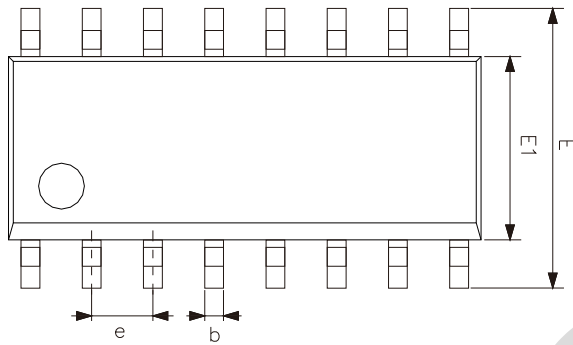
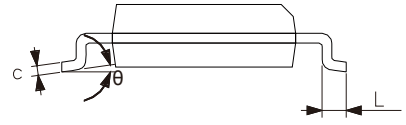
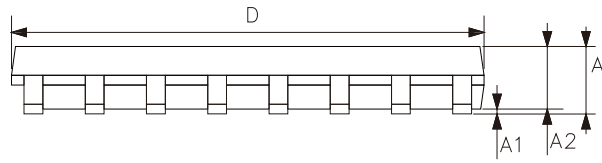
### 5.1、DIP16



Symbol	Dimensions (mm)	
	Min.	Max.
A2	3.20	3.60
A1	0.51	-
A	3.60	5.33
L	3.00	3.60
b	0.36	0.56
B1	1.52	
D	18.80	19.94
E1	6.20	6.60
e	2.54	
c	0.20	0.36
eB	7.62	9.30



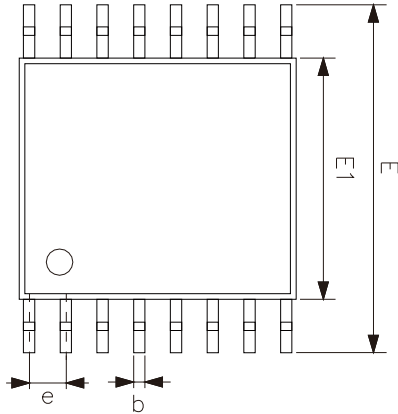
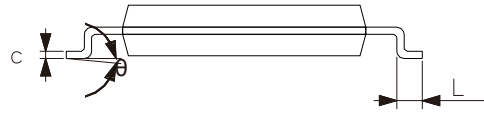
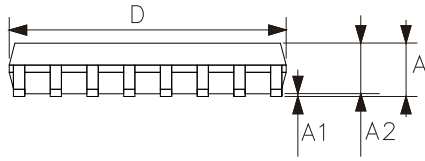
## 5.2、SOP16



Symbol	Dimensions (mm)	
	Min.	Max.
A	1.35	1.80
A1	0.10	0.25
A2	1.25	1.55
b	0.33	0.51
c	0.19	0.25
D	9.50	10.10
E	5.80	6.30
E1	3.70	4.10
e	1.27	
L	0.35	0.89
$\theta$	0°	8°



## 5.3、TSSOP16



Symbol	Dimensions (mm)	
	Min.	Max.
A	-	1.20
A1	0.05	0.15
A2	0.80	1.05
b	0.19	0.30
c	0.09	0.20
D	4.90	5.10
E1	4.30	4.50
E	6.20	6.60
e	0.65	
L	0.45	0.75
$\theta$	0°	8°



## 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、 Notes

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