



# **CD4060**

## **14-stage Ripple-carry Binary Counter/Divider and Oscillator**

### **Product Specification**

**Specification Revision History:**

<b>Version</b>	<b>Date</b>	<b>Description</b>
2019-06-A1	2019-06	New



## 1、 General Description

CD4060 is a 14-stage ripple-carry binary counter/divider and oscillator with three oscillator terminals (RS, REXT and CEXT), ten buffered outputs (Q3 to Q9 and Q11 to Q13) and an overriding asynchronous master reset input (MR).

The oscillator configuration allows design of either RC or crystal oscillator circuits. The oscillator may be replaced by an external clock signal at input RS. The counter advances on the negative-going transition of RS. A HIGH level on MR resets the counter (Q3 to Q9 and Q11 to Q13=LOW), independent of other input conditions.

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
- Tolerant of slow clock rise and fall times
- Fully static operation
- 5V, 10V, and 15V parametric ratings
- Standardized symmetrical output characteristics
- Inputs and outputs are protected against electrostatic effects
- Specified from -40°C to +85°C
- Packaging information: DIP16/SOP16/TSSOP16

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

Type number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Packing box number	Packing quantity	Notes
CD4060DA.TB	DIP16	CD4060	25 PCS/tube	40 tube/box	1000 PCS/box	10 box/pack	10000 PCS/pack	Dimensions of plastic enclosure: 19.0mm×6.4mm Pin spacing: 2.54mm
CD4060SA.TB	SOP16	CD4060	50 PCS/tube	200 tube/box	10000 PCS/box	5 box/pack	50000 PCS/pack	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing: 1.27mm
CD4060TA.TB	TSSOP16	CD4060	96 PCS/tube	120 tube/box	19200 PCS/box	10 box/pack	192000 PCS/pack	Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing: 0.65mm

**Reel packing specifications:**

Type number	Packaging form	Marking code	Reel quantity	Boxed reel quantity	Packing quantity	Notes
CD4060SA.TR	SOP16(1)	CD4060	2500 PCS/reel	5000 PCS/box	20000 PCS/pack	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing:1.27mm
CD4060SA.TR	SOP16(2)	CD4060	2500 PCS/reel	2500 PCS/box	40000 PCS/pack	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing:1.27mm
CD4060TA.TR	TSSOP16	CD4060	2500 PCS/reel	5000 PCS/box	40000 PCS/pack	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

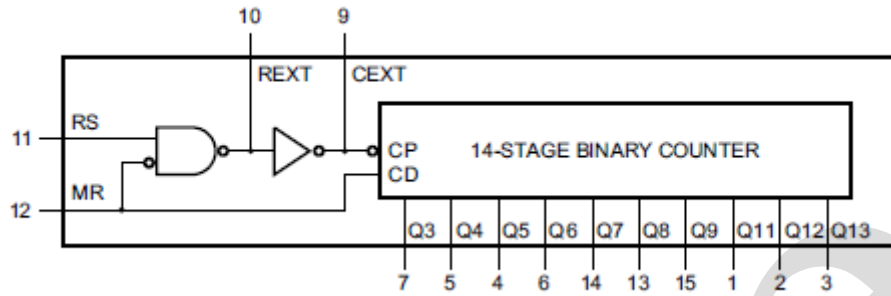


Figure 1. Functional diagram

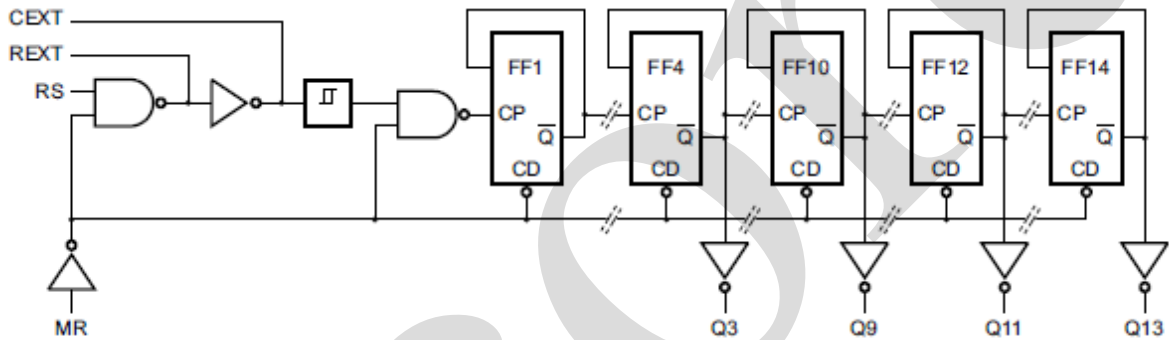
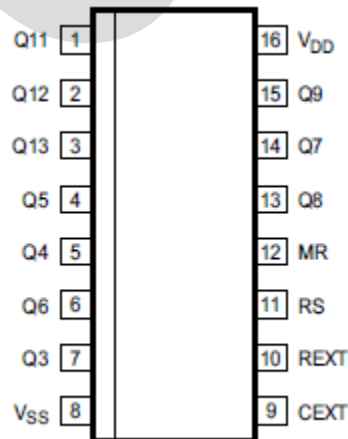


Figure 2. Logic diagram

### 2.2、Pin Configurations





## 2.3、Pin Description

Pin No.	Pin Name	Description
1	Q11	counter output
2	Q12	counter output
3	Q13	counter output
4	Q5	counter output
5	Q4	counter output
6	Q6	counter output
7	Q3	counter output
8	V <sub>SS</sub>	ground (0V)
9	CEXT	external capacitor connection
10	REXT	oscillator pin
11	RS	clock input/oscillator pin
12	MR	master reset
13	Q8	counter output
14	Q7	counter output
15	Q9	counter output
16	V <sub>DD</sub>	supply voltage

## 2.4、Function Table

Input		Output
RS	MR	Q3 to Q9 and Q11 to Q13
↑	L	no change
↓	L	count
X	H	L

Note: H=HIGH voltage level; L=LOW voltage level; X=don't care; ↑=LOW-to-HIGH 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	-	$\pm 10$	mA
input voltage	$V_I$	all inputs	-0.5	$V_{DD}+0.5$	V
storage temperature	$T_{stg}$	-	-65	+150	$^{\circ}C$
total power dissipation	$P_{tot}$	-	-	500	mW
device dissipation	P	per output transistor	-	100	mW
Soldering temperature	$T_L$	10s	DIP	245	$^{\circ}C$
			SOP	250	$^{\circ}C$

Note:

- [1] For DIP16 packages: above  $70^{\circ}C$  the value of  $P_{tot}$  derates linearly with 12mW/K.
- [2] For SOP16 packages: above  $70^{\circ}C$  the value of  $P_{tot}$  derates linearly with 8mW/K.
- [3] For (T)SSOP16 packages: above  $60^{\circ}C$  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	-	+85	$^{\circ}C$	
input pulse width	$t_w$	f=100kHz	$V_{DD}=5V$	100	-	-	ns
			$V_{DD}=10V$	40	-	-	ns
			$V_{DD}=15V$	30	-	-	ns
input pulse rise and fall time	$t_{rIN}, t_{fIN}$	$V_{DD}=5V$	unlimited			-	
		$V_{DD}=10V$				-	
		$V_{DD}=15V$				-	
input pulse frequency	$f_{RS}$	external pulse source	$V_{DD}=5V$	-	-	3.5	MHz
			$V_{DD}=10V$	-	-	8	MHz
			$V_{DD}=15V$	-	-	12	MHz
reset pulse width	$t_{wR}$	$V_{DD}=5V$	120	-	-	ns	
		$V_{DD}=10V$	60	-	-	ns	
		$V_{DD}=15V$	40	-	-	ns	



### 3.3、Electrical Characteristics

#### 3.3.1、DC Characteristics 1

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

Parameter	Symbol	Conditions (V)			$T_{amb}=25^{\circ}\text{C}$			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	-	$\pm 10^{-5}$	$\pm 0.1$	uA

#### 3.3.2、DC Characteristics 2

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

Parameter	Symbol	Conditions (V)			$T_{amb}=-40^{\circ}\text{C}$		$T_{amb}=+85^{\circ}\text{C}$		Unit
		$V_O$	$V_{IN}$	$V_{DD}$	Min.	Max.	Min.	Max.	
supply current	$I_{DD}$	-	0, 5	5	-	5	-	150	uA
		-	0, 10	10	-	10	-	300	uA
		-	0, 15	15	-	20	-	600	uA
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	-	$\pm 0.1$	-	$\pm 1$	$\mu A$

### 3.3.3、AC Characteristics 1

( $T_{amb}=25^{\circ}C$ ,  $V_{SS}=0V$ ,  $t_r, t_f=20ns$ ,  $C_L=50pF$ ,  $R_L=200k\Omega$ , unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
propagation delay time	$t_{PHL}, t_{PLH}$	RS to Q3 out; see Figure 4	$V_{DD}=5V$	-	370	740	ns
			$V_{DD}=10V$	-	150	300	ns
			$V_{DD}=15V$	-	100	200	ns
		Q <sub>n</sub> to Q <sub>n+1</sub> ; see Figure 4	$V_{DD}=5V$	-	100	200	ns
			$V_{DD}=10V$	-	50	100	ns
			$V_{DD}=15V$	-	40	80	ns
		MR to Q <sub>n</sub> ; see Figure 4	$V_{DD}=5V$	-	180	360	ns
			$V_{DD}=10V$	-	80	160	ns
			$V_{DD}=15V$	-	50	100	ns
transition time	$t_t$	see Figure 4	$V_{DD}=5V$	-	100	200	ns
			$V_{DD}=10V$	-	50	100	ns
			$V_{DD}=15V$	-	40	80	ns
pulse width	$t_w$	minimum width; f=100kHz; RS HIGH;	$V_{DD}=5V$	-	50	100	ns
			$V_{DD}=10V$	-	20	40	ns
			$V_{DD}=15V$	-	15	30	ns
		minimum width; MR HIGH; see Figure 4	$V_{DD}=5V$	-	60	120	ns
			$V_{DD}=10V$	-	30	60	ns
			$V_{DD}=15V$	-	20	40	ns
input pulse rise and fall time	$t_{rIN}, t_{fIN}$	-	$V_{DD}=5V$	unlimited			-
			$V_{DD}=10V$				-
			$V_{DD}=15V$				-
maximum clock frequency	$f_{max}$	input RS; see Figure 4	$V_{DD}=5V$	3.5	7	-	MHz
			$V_{DD}=10V$	8	16	-	MHz
			$V_{DD}=15V$	12	24	-	MHz
input capacitance	$C_I$	any input	-	5	7.5	pF	

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





### 3.3.4、 AC Characteristics 2

(RC Operation,  $T_{amb}=25^{\circ}\text{C}$ ,  $V_{SS}=0\text{V}$ ,  $t_r, t_f=20\text{ns}$ ,  $C_L=50\text{pF}$ ,  $R_L=200\text{k}\Omega$ , unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
variation of frequency (unit to unit)	-	$C_X=200\text{pF}$ $R_S=560\text{k}\Omega$ $R_X=50\text{k}\Omega$	$V_{DD}=5\text{V}$	-	$23\pm 10\%$	-	kHz
			$V_{DD}=10\text{V}$	-	$24\pm 10\%$	-	kHz
			$V_{DD}=15\text{V}$	-	$25\pm 10\%$	-	kHz
variation of frequency with voltage change (same unit)	-	$C_X=200\text{pF}$ $R_S=560\text{k}\Omega$ $R_X=50\text{k}\Omega$	5V to 10V	-	1.5	-	kHz
			10V to 15V	-	0.5	-	kHz
$R_X$ max	-	$C_X=10\mu\text{F}, V_{DD}=5\text{V}$	-	-	20	$\text{M}\Omega$	
		$C_X=50\mu\text{F}, V_{DD}=10\text{V}$	-	-	20	$\text{M}\Omega$	
		$C_X=10\mu\text{F}, V_{DD}=15\text{V}$	-	-	10	$\text{M}\Omega$	
$C_X$ max	-	$R_X=500\text{k}\Omega, V_{DD}=5\text{V}$	-	-	1000	$\mu\text{F}$	
		$R_X=300\text{k}\Omega, V_{DD}=10\text{V}$	-	-	50	$\mu\text{F}$	
		$R_X=300\text{k}\Omega, V_{DD}=15\text{V}$	-	-	50	$\mu\text{F}$	
Maximum oscillator frequency	-	$C_X=15\text{pF}$ $R_S=30\text{k}\Omega$ $R_X=15\text{k}\Omega$	$V_{DD}=10\text{V}$	530	650	810	kHz
			$V_{DD}=15\text{V}$	690	800	940	kHz
drive current at CEXT (for oscillator design)	$I_{OL}$	$V_O=0.4\text{V}, V_{DD}=5\text{V}$	0.16	0.35	-	mA	
		$V_O=0.5\text{V}, V_{DD}=10\text{V}$	0.42	0.8	-	mA	
		$V_O=1.5\text{V}, V_{DD}=15\text{V}$	1	2	-	mA	
	$I_{OH}$	$V_O=4.6\text{V}, V_{DD}=5\text{V}$	-0.16	-0.35	-	mA	
		$V_O=9.5\text{V}, V_{DD}=10\text{V}$	-0.42	-0.8	-	mA	
		$V_O=13.5\text{V}, V_{DD}=15\text{V}$	-1	-2	-	mA	

Note: RC oscillator applications are not recommended at supply voltages below 7V for  $R_X < 50\text{k}\Omega$ .



## 4、 Testing Circuit

### 4.1、 AC Testing Circuit

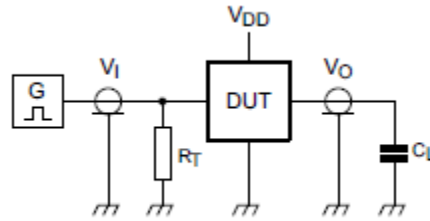


Figure 3. Test circuit for switching times

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.

### 4.2、 AC Testing Waveforms

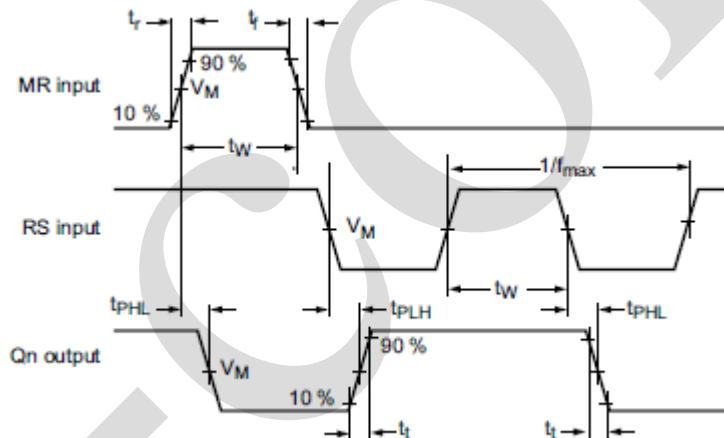


Figure 4. Waveforms showing propagation delays

### 4.3、 Measurement Points

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

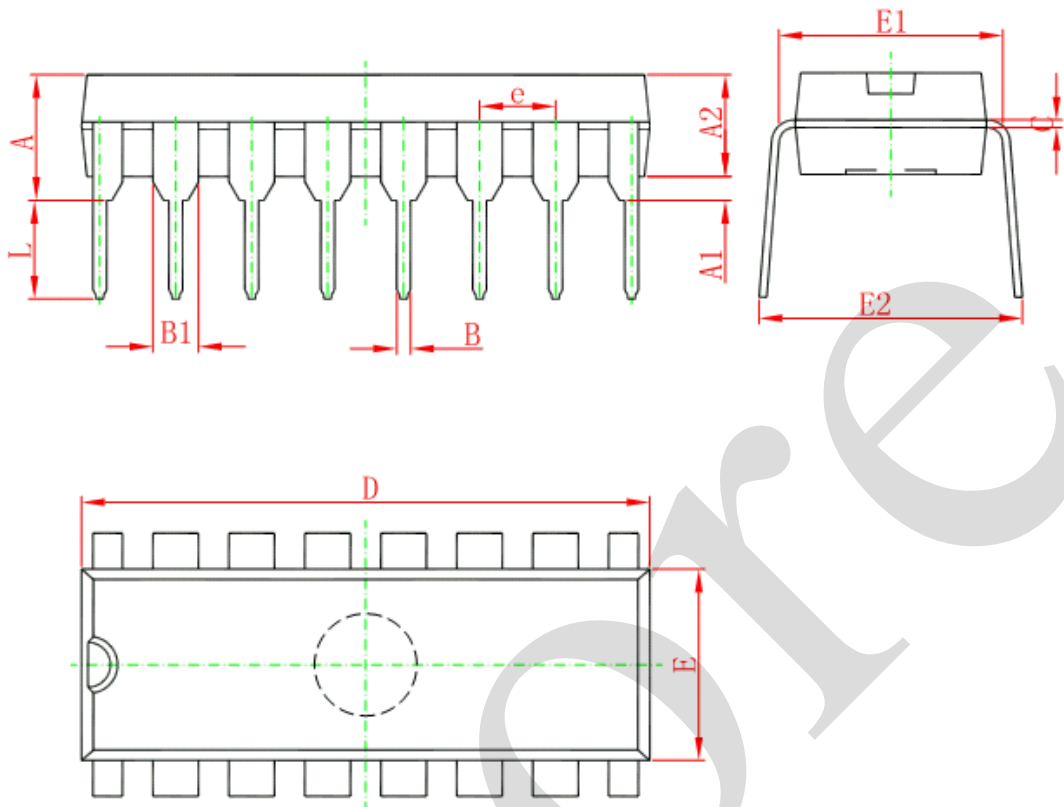
### 4.4、 Test Data

Supply voltage	Input		Load
$V_{DD}$	$V_I$	$t_r, t_f$	$C_L$
5V to 15V	$V_{SS}$ or $V_{DD}$	$\leq 20\text{ns}$	50pF



## 5、 Package Information

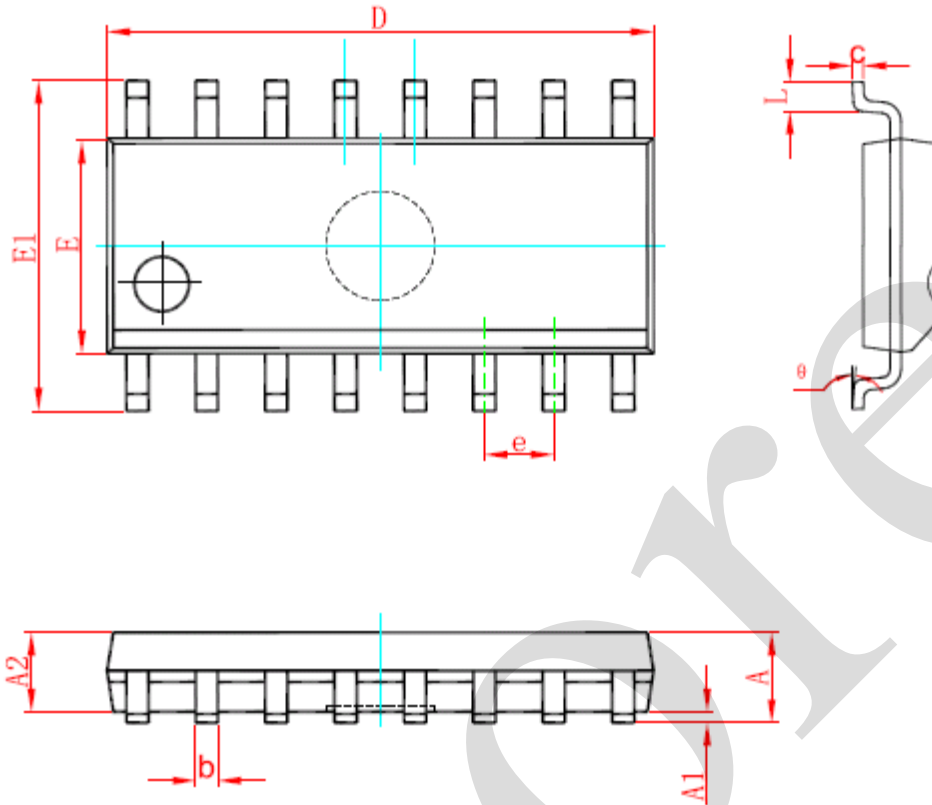
### 5.1、 DIP16



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



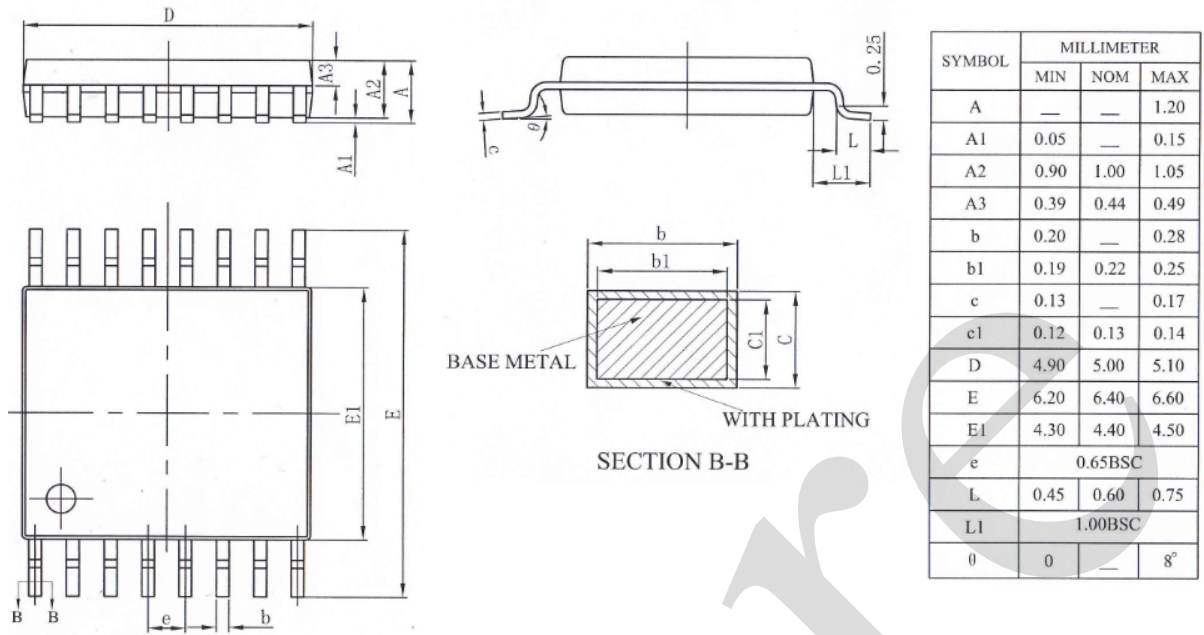
## 5.2、SOP16



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	○: Indicates that the content of hazardous substances or elements in the detection limit of the following the SJ/T11363-2006 standard. ×: Indicates that the content of hazardous substances or elements exceeding the SJ/T11363-2006 Standard limit requirements.									

### 6.2、 Notion

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

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[CD4060BM\(LX\)](#) [CD4060BE\(LX\)](#) [CD4518BE\(LX\)](#) [CD4520BE\(LX\)](#) [SN74HC192N\(XBLW\)](#) [CD4040BM\(LX\)](#) [CD4026BM\(LX\)](#)  
[CD40103BDR\(LX\)](#) [SN74LS192DR\(LX\)](#) [SN74HC161DR \(LX\)](#)