



CD4538

Dual Precision Monostable Multivibrator

Product Specification

Specification Revision History:

Version	Date	Description
2019-06-A1	2019-06	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 CD4538 is a dual retriggerable-resettable monostable multivibrator. Each multivibrator has an active LOW trigger/retrigger input (\overline{nA}), an active HIGH trigger/retrigger input (nB), an overriding active LOW direct reset input (\overline{nCD}), an output (nQ) and its complement (\overline{nQ}), and two pins ($nREXT/CEXT$, and $nCEXT$, always connected to ground) for connecting the external timing components C_{EXT} and R_{EXT} . Typical pulse width variation over the specified temperature range is $\pm 0.2\%$.

The multivibrator may be triggered by either the positive or the negative edges of the input pulse and will produce an accurate output pulse with a pulse width range of 10 μ s to infinity. The duration and accuracy of the output pulse are determined by the external timing components C_{EXT} and R_{EXT} . The output pulse width (t_W) is equal to $R_{EXT} \times C_{EXT}$. The linear design techniques in LOC MOS (Local Oxide CMOS) guarantee precise control of the output pulse width. A LOW level at \overline{nCD} terminates the output pulse immediately.

It operates over a recommended V_{DD} power supply range of 3V to 12V 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 12V
- Tolerant of slow trigger rise and fall times
- Fully static operation
- 5V and 10V 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
CD4538DA16.TB	DIP16	CD4538	25 PCS/tube	40 tube/box	1000 PCS/box	Dimensions of plastic enclosure: 19.0mm×6.4mm Pin spacing: 2.54mm
CD4538SA16.TB	SOP16	CD4538	50 PCS/tube	200 tube/box	10000 PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing: 1.27mm
CD4538TA16.TB	TSSOP16	CD4538	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
CD4538SA16.TR	SOP16	CD4538	4000 PCS/reel	8000 PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing:1.27mm
CD4538TA16.TR	TSSOP16	CD4538	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

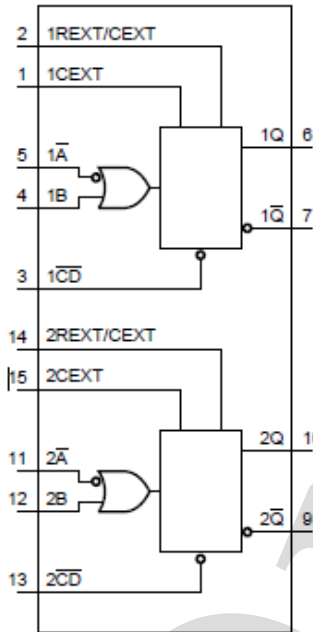


Figure 1. Functional diagram

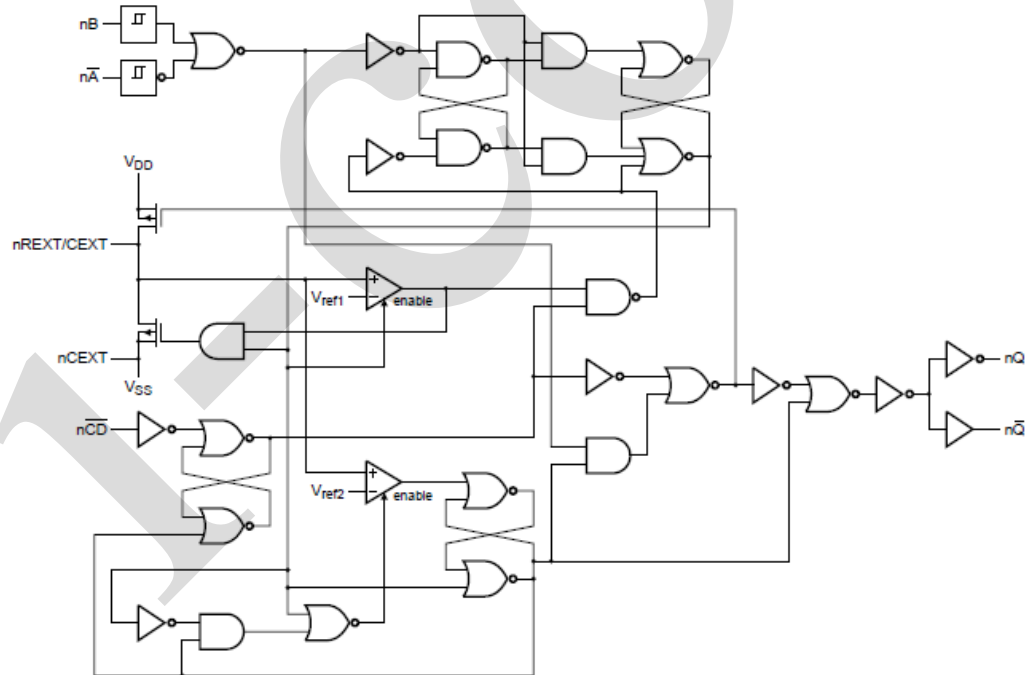
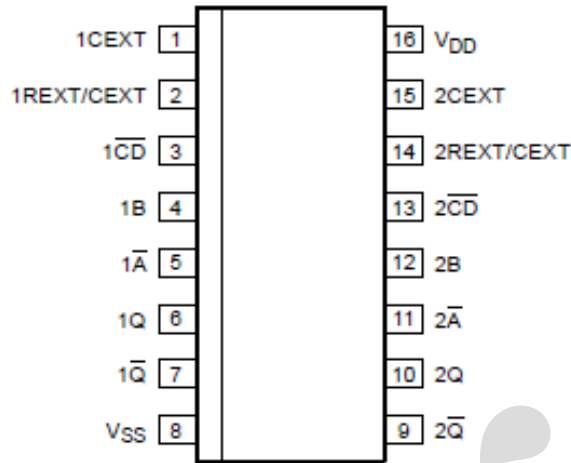


Figure 2. Logic diagram (one multivibrator)



2.2、Pin Configurations



2.3、Pin Description

Pin No.	Pin Name	Description
1	1CEXT	external capacitor connection (always connected to ground)
2	1REXT/CEXT	external capacitor/resistor connection
3	1 \overline{CD}	direct reset input (active LOW)
4	1B	input (LOW-to-HIGH triggered)
5	1 \overline{A}	input (HIGH-to-LOW triggered)
6	1Q	output
7	1 \overline{Q}	complementary output (active LOW)
8	V _{SS}	ground (0V)
9	2 \overline{Q}	complementary output (active LOW)
10	2Q	output
11	2 \overline{A}	input (HIGH-to-LOW triggered)
12	2B	input (LOW-to-HIGH triggered)
13	2 \overline{CD}	clear direct input (active LOW)
14	2REXT/CEXT	external capacitor/resistor connection
15	2CEXT	external capacitor connection (always connected to ground)
16	V _{DD}	supply voltage



2.4、Function Table

Input			Output	
\bar{nA}	nB	$n\bar{CD}$	nQ	$n\bar{Q}$
↓	L	H		
H	↑	H		
X	X	L	L	H

Note:

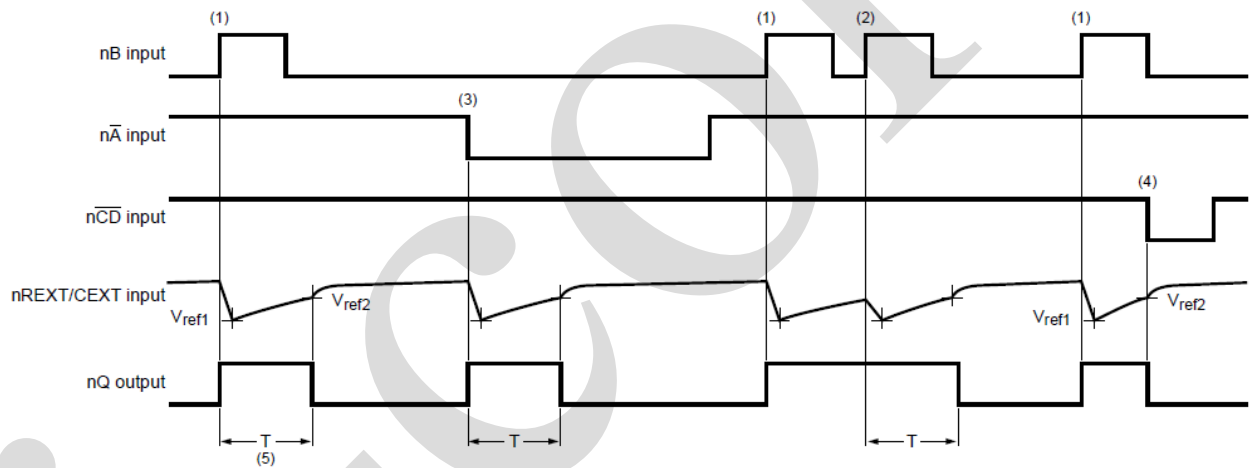
[1] H=HIGH voltage level; L=LOW voltage level; X=don't care;

[2] ↑=positive-going clock transition; ↓=negative-going transition;

[3] =one HIGH level output pulse, with the pulse width determined by C_{EXT} and R_{EXT} ;

[4] =one LOW level output pulse, with the pulse width determined by C_{EXT} and R_{EXT} .

2.4.1、Timing Diagram



(1) Positive edge triggering.

(2) Positive edge re-triggering (pulse lengthening).

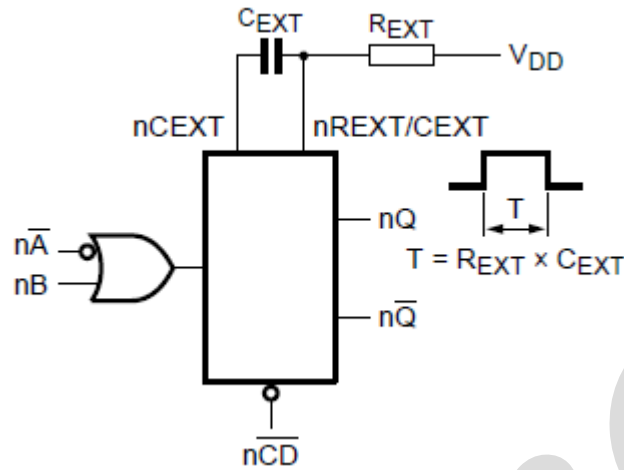
(3) Negative edge triggering.

(4) Reset (pulse shortening).

(5) $T = R_{EXT} \times C_{EXT}$.



2.4.2、 Connection Of The External Timing Components REXT And CEXT



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	+14	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	

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	-	12	V
ambient temperature	T _{amb}	in free air	-40	-	+105	°C



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			$T_{amb}=25^{\circ}\text{C}$			Unit
		$ I_O (\mu\text{A})$	$V_O(\text{V})$	$V_{DD}(\text{V})$	Min.	Typ.	Max.	
supply current	I_{DD}	active state $V_I=V_{SS}$ or V_{DD}		5	-	55	-	μA
				10	-	150	-	μA
LOW-level output current	I_{OL}	-	0.4	5	0.5	-	-	mA
		-	0.5	10	1.3	-	-	mA
HIGH-level output current	I_{OH}	-	2.5	5	-	-	-1.4	mA
		-	4.6	5	-	-	-0.5	mA
		-	9.5	10	-	-	-1.3	mA
LOW-level output voltage	V_{OL}	<1	-	5	-	-	0.05	V
		<1	-	10	-	-	0.05	V
HIGH-level output voltage	V_{OH}	<1	-	5	4.95	-	-	V
		<1	-	10	9.95	-	-	V
LOW-level input voltage	V_{IL}	<1	-	5	-	-	1.5	V
		<1	-	10	-	-	3	V
HIGH-level input voltage	V_{IH}	<1	-	5	3.5	-	-	V
		<1	-	10	7	-	-	V
input leakage current	I_I	nA, nB		12	-	-	± 0.1	μA
		nREXT/CEXT		12	-	-	± 0.1	μA

3.3.2、DC Characteristics 2

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

Parameter	Symbol	Conditions			$T_{amb}=-40^{\circ}\text{C}$		$T_{amb}=+85^{\circ}\text{C}$		$T_{amb}=+105^{\circ}\text{C}$		Unit
		$ I_O (\mu\text{A})$	$V_O(\text{V})$	$V_{DD}(\text{V})$	Min.	Max.	Min.	Max.	Min.	Max.	
LOW-level output current	I_{OL}	-	0.4	5	0.64	-	0.36	-	0.36	-	mA
		-	0.5	10	1.6	-	0.9	-	0.9	-	mA
HIGH-level output current	I_{OH}	-	2.5	5	-	-1.7	-	-1.1	-	-1.1	mA
		-	4.6	5	-	-0.64	-	-0.36	-	-0.36	mA
		-	9.5	10	-	-1.6	-	-0.9	-	-0.9	mA
LOW-level output voltage	V_{OL}	<1	-	5	-	0.05	-	0.05	-	0.05	V
		<1	-	10	-	0.05	-	0.05	-	0.05	V
HIGH-level output voltage	V_{OH}	<1	-	5	4.95	-	4.95	-	4.95	-	V
		<1	-	10	9.95	-	9.95	-	9.95	-	V
LOW-level input voltage	V_{IL}	<1	-	5	-	1.5	-	1.5	-	1.5	V
		<1	-	10	-	3.0	-	3.0	-	3.0	V
HIGH-level input voltage	V_{IH}	<1	-	5	3.5	-	3.5	-	3.5	-	V
		<1	-	10	7.0	-	7.0	-	7.0	-	V
input leakage current	I_I	nA, nB		12	-	± 0.1	-	± 1.0	-	± 1.0	μA
		nREXT/CEXT		12	-	± 0.3	-	± 1.0	-	± 1.0	μA



3.3.3. AC Characteristics

($T_{amb}=25^{\circ}C$, $V_{SS}=0V$, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit		
HIGH to LOW propagation delay	t_{PHL}	\overline{nA} or \overline{nB} to \overline{nQ} ; see Figure 4	$V_{DD}=5V$	-	220	440	ns	
			$V_{DD}=10V$	-	85	190	ns	
		\overline{nCD} to \overline{nQ} ; see Figure 4	$V_{DD}=5V$	-	125	250	ns	
			$V_{DD}=10V$	-	55	110	ns	
LOW to HIGH propagation delay	t_{PLH}	\overline{nA} or \overline{nB} to \overline{nQ} ; see Figure 4	$V_{DD}=5V$	-	200	460	ns	
			$V_{DD}=10V$	-	90	180	ns	
		\overline{nCD} to \overline{nQ} ; see Figure 4	$V_{DD}=5V$	-	125	250	ns	
			$V_{DD}=10V$	-	55	110	ns	
transition time	t_t	see Figure 4	$V_{DD}=5V$	-	60	120	ns	
			$V_{DD}=10V$	-	30	60	ns	
recovery time	t_{rec}	\overline{nCD} to \overline{nA} or \overline{nB} ; see Figure 5	$V_{DD}=5V$	-	20	40	ns	
			$V_{DD}=10V$	-	10	20	ns	
retrigger time	t_{trig}	\overline{nQ} , \overline{nQ} to \overline{nA} , \overline{nB} ; see Figure 5	$V_{DD}=5V$	0	-	-	ns	
			$V_{DD}=10V$	0	-	-	ns	
pulse width	t_w	\overline{nA} LOW; minimum width; see Figure 5	$V_{DD}=5V$	90	45	-	ns	
			$V_{DD}=10V$	30	15	-	ns	
		\overline{nB} HIGH; minimum width; see Figure 5	$V_{DD}=5V$	50	25	-	ns	
			$V_{DD}=10V$	24	12	-	ns	
		\overline{nCD} LOW; minimum width; see Figure 5	$V_{DD}=5V$	55	25	-	ns	
			$V_{DD}=10V$	25	12	-	ns	
		\overline{nQ} or \overline{nQ} ; $R_{EXT}=100k\Omega$; $C_{EXT}=2nF$; see Figure 5	$V_{DD}=5V$	218	230	242	us	
			$V_{DD}=10V$	213	224	235	us	
		\overline{nQ} or \overline{nQ} ; $R_{EXT}=100k\Omega$; $C_{EXT}=0.1\mu F$; see Figure 5	$V_{DD}=5V$	10.3	10.8	11.3	ms	
			$V_{DD}=10V$	10.2	10.7	11.2	ms	
\overline{nQ} or \overline{nQ} ; $R_{EXT}=100k\Omega$; $C_{EXT}=10\mu F$; see Figure 5	$V_{DD}=5V$	1.01	1.09	1.11	s			
	$V_{DD}=10V$	0.99	1.04	1.09	s			
pulse width variation	Δt_w	\overline{nQ} or \overline{nQ} variation over temperature range; see Figure 6	$V_{DD}=5V$	-	± 0.2	-	%	
			$V_{DD}=10V$	-	± 0.2	-	%	
		\overline{nQ} or \overline{nQ} variation over V_{DD} voltage range 5V to 12V; see Figure 7		-	-	± 1.5	-	%
		\overline{nQ} or \overline{nQ} variation between monostables in the same device; $R_{EXT}=100k\Omega$; $C_{EXT}=2nF$ to $10\mu F$	$V_{DD}=5V$	-	± 1	-	%	
			$V_{DD}=10V$	-	± 1	-	%	
external timing resistor	R_{EXT}	-	5	-	-	k Ω		



external timing capacitor	C_{EXT}	-	2000	-	no limits	pF
input capacitance	C_I	-	-	-	7.5	pF

Note:

[1] t_i is the same as t_{TLH} and t_{THL} .

[2] The maximum permissible resistance R_{EXT} , which holds the specified accuracy of t_w (nQ, $\bar{n}Q$ output), depends on the leakage current of the capacitor C_{EXT} and the leakage current of the CD4538.

4、Testing Circuit

4.1、AC Testing Circuit

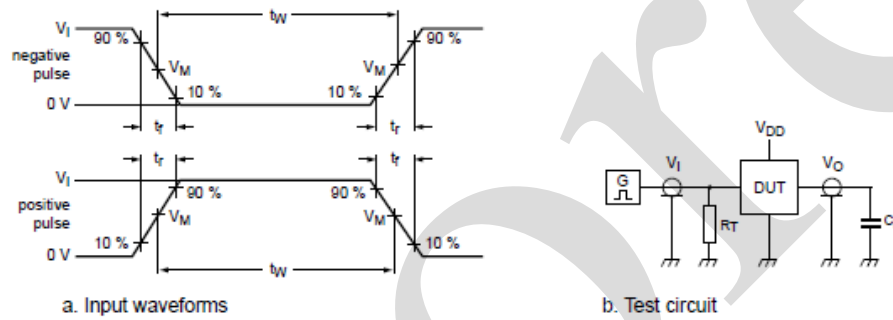


Figure 3. Test circuit for switching times

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

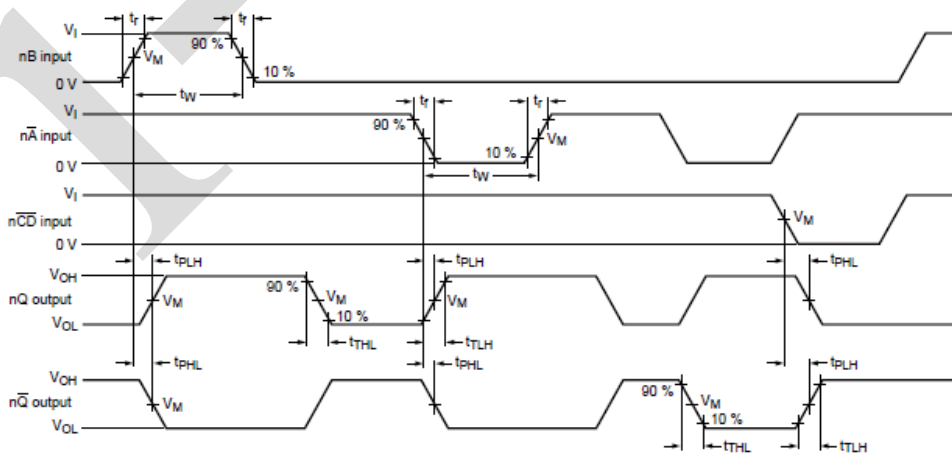


Figure 4. Waveforms showing propagation delays

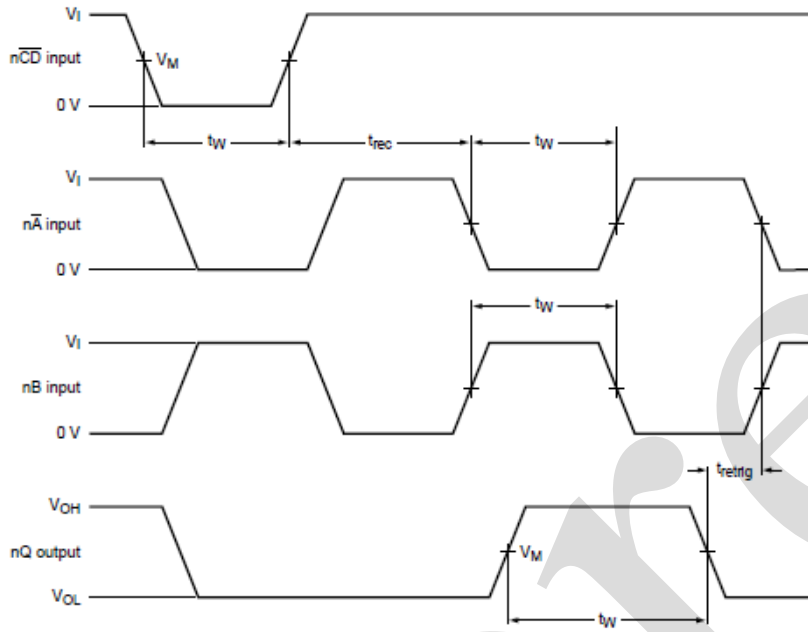
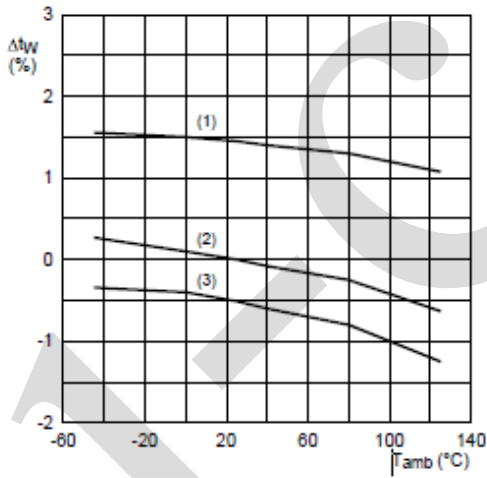
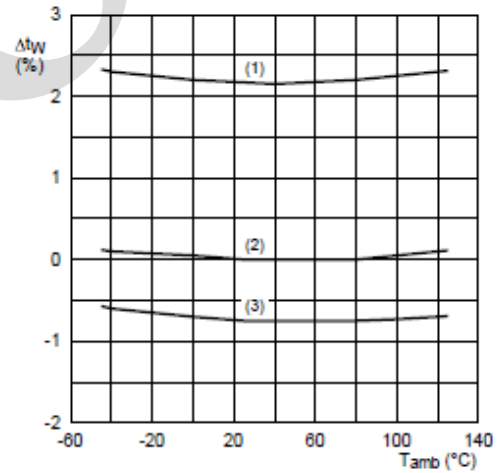


Figure 5. Waveforms showing minimum $n\bar{C}D$, $n\bar{A}$, nB , and nQ pulse widths, recovery and retrigger times

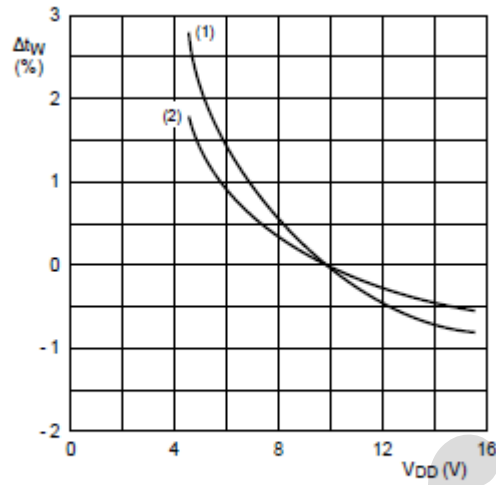


a. $R_{EXT} = 100\text{ k}\Omega$; $C_{EXT} = 100\text{ nF}$
(1) $V_{DD} = 5\text{ V}$
(2) $V_{DD} = 10\text{ V}$
(3) $V_{DD} = 15\text{ V}$
 $\Delta t_W = 0\%$ at $V_{DD} = 10\text{ V}$ and $T_{amb} = 25\text{ }^\circ\text{C}$



b. $R_{EXT} = 100\text{ k}\Omega$; $C_{EXT} = 2\text{ nF}$
(1) $V_{DD} = 5\text{ V}$
(2) $V_{DD} = 10\text{ V}$
(3) $V_{DD} = 15\text{ V}$
 $\Delta t_W = 0\%$ at $V_{DD} = 10\text{ V}$ and $T_{amb} = 25\text{ }^\circ\text{C}$

Figure 6. Typical normalized change in output pulse width as a function of ambient temperature



$T_{amb} = 25\text{ }^{\circ}\text{C}$; $\Delta t_W = 0\%$ at $V_{DD} = 10\text{ V}$; $R_{EXT} = 100\text{ k}\Omega$
 (1) $C_{EXT} = 2\text{ nF}$
 (2) $C_{EXT} = 100\text{ nF}$

Figure 7. Typical normalized change in output pulse width as a function of the supply voltage

4.3. Measurement Points

Supply voltage	Input	Output
V_{DD}	V_M	V_M
5V to 12V	$0.5 \times V_{DD}$	$0.5 \times V_{DD}$

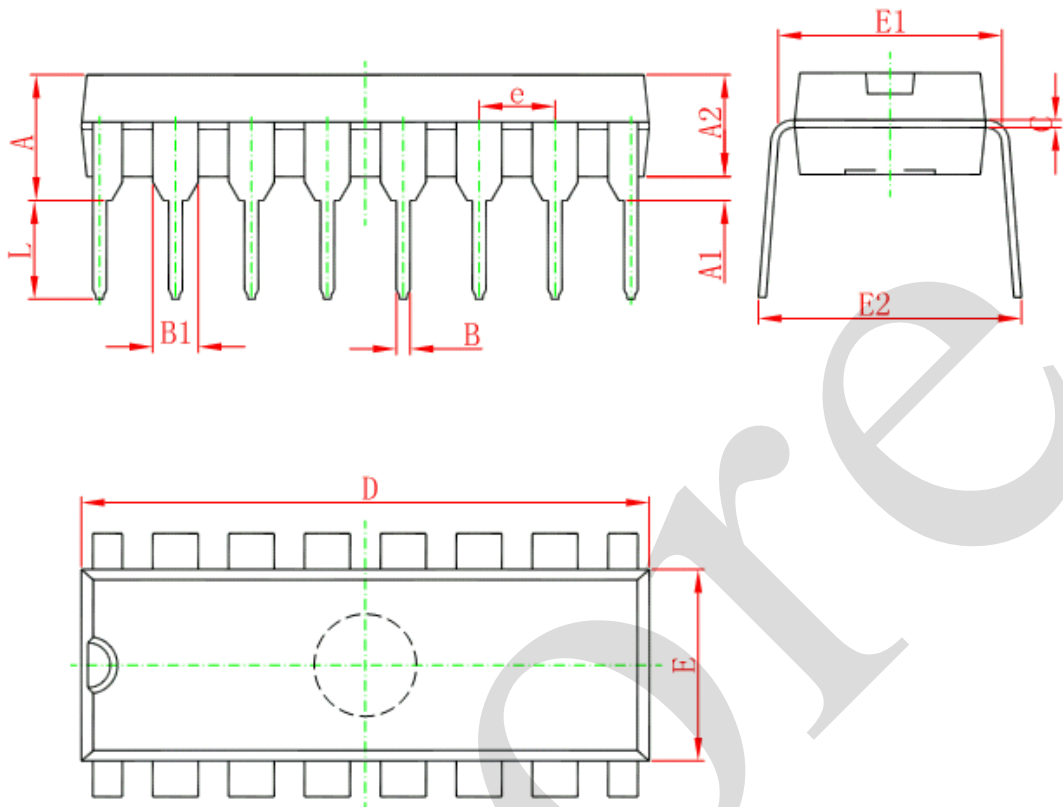
4.4. Test Data

Supply voltage	Input		Load
V_{DD}	V_I	t_r, t_f	C_L
5V to 12V	V_{SS} or V_{DD}	$\leq 20\text{ ns}$	50pF



5、Package Information

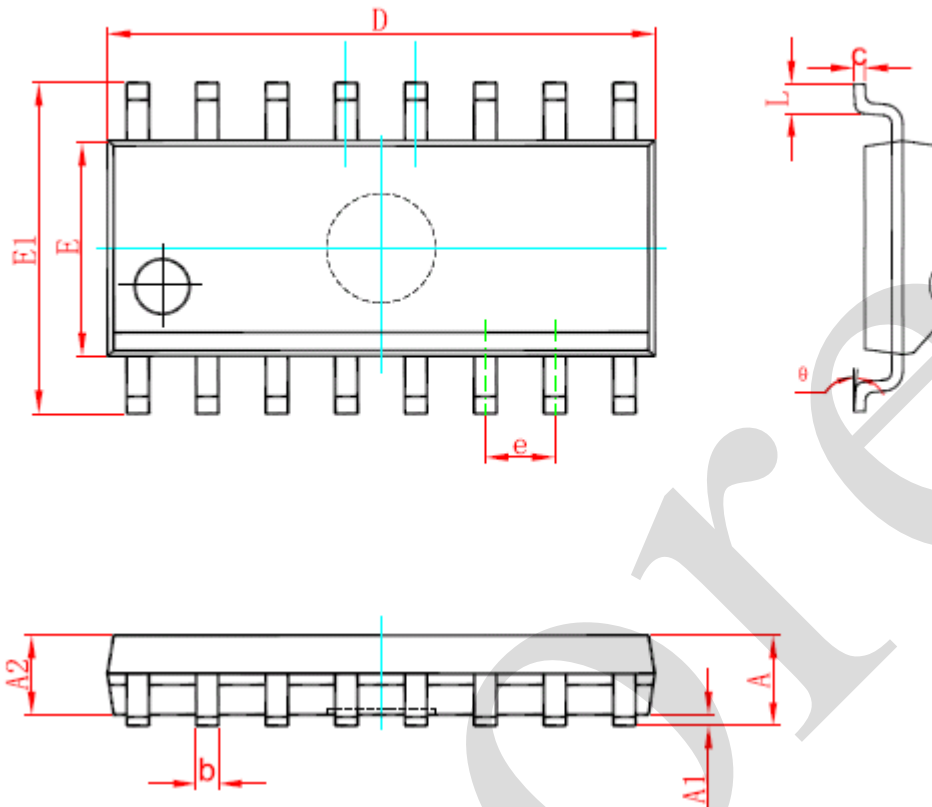
5.1、DIP16



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



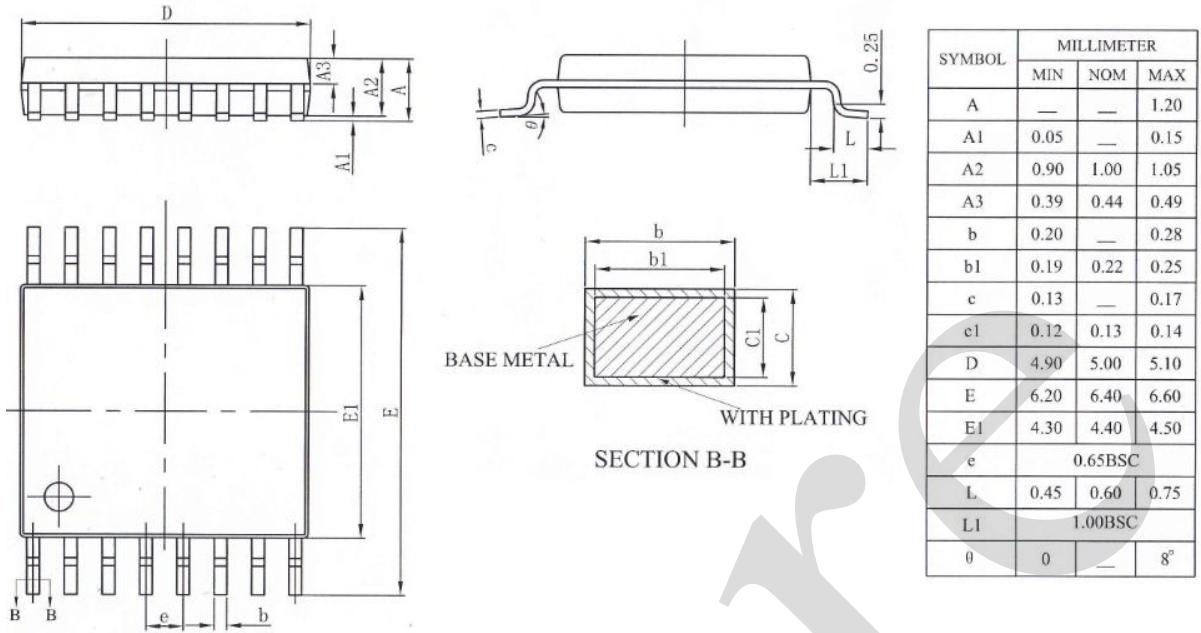
5.2、SOP16



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

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