

Dual Retriggerable Monostable Multivibrator

The TC74HC423A is a high speed CMOS MONOSTABLE MULTIMBRATOR fabricated with silicon gate C²MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

There are two trigger inputs, \bar{A} input (Negative edge), and B input (Positive edge). These inputs are valid for a slow rise/fall time signal ($t_r = t_f = 1\text{sec.}$) as they are Schmitt trigger inputs.

After triggering, the output stays in a MONOSTABLE state for a time period determined by the external resistor and capacitor (Rx, Cx). A low level at the $\overline{\text{CLR}}$ input breaks the state. In the MONO STABLE state, if a new trigger is applied, it extends the MONOSTABLE period (retrigger mode).

Limitations for Cx and Rx are:

External capacitor Cx...No limit

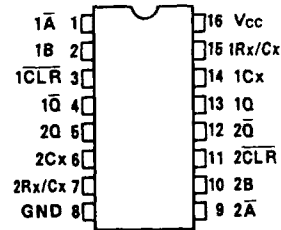
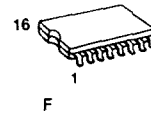
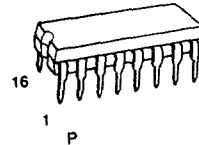
External resistor Rx... $V_{CC} = 1.0\text{V}$ more than $5\text{k}\Omega$

$V_{CC} \geq 3.0\text{V}$ more than $1\text{k}\Omega$

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

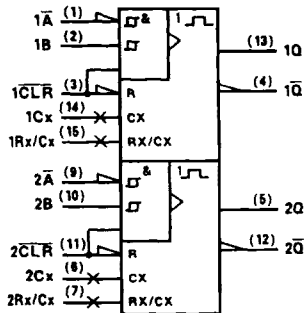
Features

- High Speed: $t_{pd} = 25\text{ns}$ (Typ.) at $V_{CC} = 5\text{V}$
- Low Power Dissipation:
 - Standby State $I_{CC} = 4\mu\text{A}$ (Max.) at $T_a = 25^\circ\text{C}$
 - Active State $I_{CC} = 700\mu\text{A}$ (Max.) at $T_a = 25^\circ\text{C}$
- High Noise Immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (Min)
- Output Drive Capability: 10 LSTTL Loads
- Symmetrical Output Impedance: $I_{OH} = I_{OL} = 4\text{mA}$ (Min.)
- Balanced Propagation Delays: $t_{pLH} = t_{pHL}$
- Wide Operating Voltage Range: $V_{CC(\text{opr})} = 2\text{V} \sim 6\text{V}$
- Pin and Function Compatible with 74LS221



(TOP VIEW)

Pin Assignment

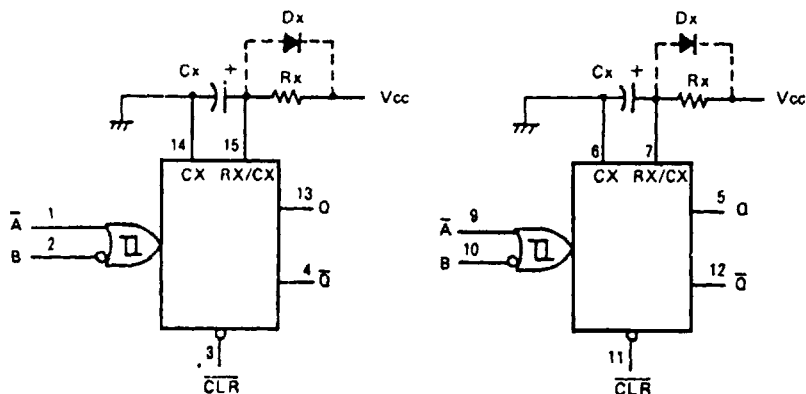


IEC Logic Symbol

Truth Table

Input			Output		Note
\bar{A}	B	CLR	Q	\bar{Q}	
L	H	H			Output Enable
X	L	H	L	H	Inhibit
H	X	H	L	H	Inhibit
L		H			Output Enable
X	X	L	L	H	Inhibit

X: Don't Care



Block Diagram

Notes: (1) Cx,Rx,Dx are external Capacitor, Resistor, and Diode, respectively.
 (2) External clamping diode, Dx;

The external capacitor is charged to V_{CC} level in the wait state, i.e., when no trigger is applied. If the supply voltage is turned off, Cx is discharged mainly through the internal (parasitic) diode. If Cx is sufficiently large and V_{CC} drops rapidly, there will be some possibility of damaging the IC through inrush current or latch-up. If the capacitance of the supply voltage filter is large enough and V_{CC} drops slowly, the inrush current is automatically limited and damage to the IC is avoided.

The maximum value of forward current through the parasitic diode is ±20mA.

In the case of a large Cx, the limit of fall time of the supply voltage is determined as follows:

$$t_f \geq (V_{CC} - 0.7) Cx / 20mA$$

(t_f is the time between the supply voltage turn off and the supply voltage reaching 0.4 V_{CC}.)

In the event a system does not satisfy the above condition, an external clamping diode (Dx) is needed to protect the IC from inrush current.

Functional Description

(1) Standby State

The external capacitor (Cx) is fully charge to V_{CC} in the standby state. That means, before triggering, the Q_p and Q_N transistors which are connected to the Rx/Cx node are in the off state. Two comparators that relate to the timing of the output pulse, and two reference voltage supplies turn off. the total supply current is only leakage current.

(2) Trigger operations

Trigger operation is effective in any of the following three cases. First, the condition where the \bar{A} input is low, and the B input has a rising signal; second, where the B input is high, and the \bar{A} input has a falling signal; and third, where the \bar{A} input is low and the B input is high, and the \overline{CLR} input has a rising signal.

After a trigger becomes effective, comparators C1 and C2 start operating, and Q_N is turned on. The external capacitor discharges through Q_N. The voltage level at the Rx/Cx node drops. If the Rx/Cx voltage level falls to the internal reference voltage V_{ref L}, the output of C1 becomes low. The flip-flop is then reset and Q_N turns off. At that moment C1 stops but C2 continues operating.

After Q_N turns off, the voltage at the Rx/Cx node starts rising at a rate determined by the time constant of external capacitor Cx and resistor Rx.

Upon the triggering, output Q becomes high, following some delay time of the internal F/F and gates. It stays high even if the voltage of Rx/Cx changes from falling to rising. When Rx/Cx reaches the internal reference voltage V_{ref H}, the output of C2 becomes low, the output Q goes low and C2 stops its operations. That means, after triggering, when the voltage level of the Rx/Cx reaches V_{ref H}, the IC returns to its MONOSTABLE state.

With large value of Cx and Rx, and ignoring the discharge time of the capacitor and internal delays of the IC, the width of the output pulse tw(OUT) is as follows:

$$tw(OUT) = 1.0 \cdot Cx \cdot Rx$$

(3) Reset operation

In normal operation, \overline{CLR} input is held high. If \overline{CLR} is low, a trigger has no effect because the Q output is held low and trigger control F/F is reset. Also Q_p turns on and Cx is charged rapidly to V_{CC}.

This means if \overline{CLR} input is set low, the IC goes into a wait state.

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Supply Voltage Range	V_{CC}	-0.5 - 7	V
DC Input Voltage	V_{IN}	-0.5 - $V_{CC} + 0.5$	V
DC Output Voltage	V_{OUT}	-0.5 - $V_{CC} + 0.5$	V
Input Diode Current	I_{IK}	±20	mA
Output Diode Current	I_{OK}	±20	mA
DC Output Current	I_{OUT}	±25	mA
DC V_{CC} /Ground Current	I_{CC}	±50	mA
Power Dissipation	P_D	500(DIP)* / 180(SOIC)	mW
Storage Temperature	T_{stg}	-65 - 150	°C
Lead Temperature 10sec	T_L	300	°C

*500mW in the range of $T_a = -40^{\circ}\text{C} \sim 65^{\circ}\text{C}$. From $T_a = 65^{\circ}\text{C}$ to 85°C a derating factor of $-10\text{mW}/^{\circ}\text{C}$ shall be applied until 300mW.

Recommended Operating Conditions

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	2 - 6	V
Input Voltage	V_{IN}	0 - V_{CC}	V
Output Voltage	V_{OUT}	0 - V_{CC}	V
Operating Temperature	T_{opr}	-40 - 85	°C
Input Rise and Fall Time (CLR Only)	t_r, t_f	0-1000($V_{CC} = 2.0\text{V}$) 0 - 500($V_{CC} = 4.5\text{V}$) 0 - 400($V_{CC} = 6.0\text{V}$)	ns
External Capacitor	C_x	No Limitation*	F
External Resistor	R_x	$\geq 5\text{K}^*(V_{CC} = 2.0\text{V})$ $\geq 1\text{K}^*(V_{CC} \geq 3.0\text{V})$	Ω

- * The maximum allowable values of C_x and R_x are a function of leakage of capacitor C_x , the leakage of TC74HC423A, and leakage due to board layout an surface resistance. Susceptibility to externally induced noise signals may occur for $R_x > 1\text{M}\Omega$.

DC Electrical Characteristics

Parameter	Symbol	Test Condition	Ta = 25°C			Ta = -40 ~ 85°C		Unit		
			V _{CC}	Min.	Typ.	Max.	Min.		Max.	
High-Level Input Voltage	V _{IH}	-	2.0	1.5	-	-	1.5	-	V	
			4.5	3.15	-	-	3.15	-		
			6.0	4.2	-	-	4.2	-		
Low-Level Input Voltage	V _{IL}	-	2.0	-	-	0.5	-	0.5	V	
			4.5	-	-	1.35	-	1.35		
			6.0	-	-	1.8	-	1.8		
High-Level Output Voltage (Q, \bar{Q})	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -20μA	2.0	1.9	2.0	-	1.9	-	V
				4.5	4.4	4.5	-	4.4	-	
			I _{OH} = -4 mA I _{OH} = -5.2mA	4.5	4.18	4.31	-	4.13	-	
				6.0	5.68	5.80	-	5.63	-	
Low-Level Output Voltage (Q, \bar{Q})	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 20μA	2.0	-	0.0	0.1	-	0.1	V
				4.5	-	0.0	0.1	-	0.1	
			I _{OL} = 4 mA I _{OL} = 5.2mA	4.5	-	0.17	0.26	-	0.33	
				6.0	-	0.18	0.26	-	0.33	
Input Leakage Current	I _{IN}	V _{IN} = V _{CC} or GND	6.0	-	-	±0.1	-	±1.0	μA	
Rx/Cx Terminal Off-State Current	I _{IN}	V _{IN} = V _{CC} or GND	6.0	-	-	±0.5	-	±5.0		
Quiescent Supply Current	I _{CC}	V _{IN} = V _{CC} or GND	6.0	-	-	-	-	40.0		
Active-State* Supply Current	I _{CC}	V _{IN} = V _{CC} or GND Rx/Cx = 0.5V _{CC}	2.0	-	45	200	-	260	μA	
			4.5	-	400	500	-	650	μA	
			6.0	-	0.7	1.0	-	1.3	mA	

*: per circuit

Timing Requirements (Input t_r = t_f = 6ns)

Parameter	Symbol	Test Condition	Ta = 25°C			Ta = -40 ~ 85°C		Unit
			V _{CC}	Typ.	Limit	Limit		
Minimum Pulse Width	t _{W(H)} t _{W(L)}	-	2.0	-	75	95	ns	
			4.5	-	15	19		
			6.0	-	13	16		
Minimum Clear Width	t _{W(L)}	-	2.0	-	75	95	ns	
			4.5	-	15	19		
			6.0	-	13	16		
Minimum Clear Removal	t _{rem}	-	2.0	-	5	5	ns	
			4.5	-	5	5		
			6.0	-	5	5		
Minimum Retrigger Time	t _{tr}	Rx = 1KΩ Cx = 0.01pF	2.0	325	-	-	μA	
			4.5	108	-	-		
			6.0	78	-	-		
		Rx = 1KΩ Cx = 0.01pF	2.0	5.0	-	-		
			4.5	1.4	-	-		
			6.0	1.2	-	-		

AC Electrical Characteristics ($C_L = 15\text{pF}$, $V_{CC} = 5\text{V}$, $T_a = 25^\circ\text{C}$, Input $t_r = t_f = 6\text{ns}$)

Parameter	Symbol	Test Conditon	Min.	Typ.	Max.	Unit
Output Transition Time	t_{TLH} t_{THL}	-	-	4	8	ns
Propagation Delay Time (A, B-Q, Q)	t_{PLH} t_{PHL}	-	-	25	36	
Propagation Delay Time (CE-Q, Q)	t_{PLH} t_{PHL}	-	-	16	27	

AC Electrical Characteristics ($C_L = 50\text{pF}$, Input $t_r = t_f = 6\text{ns}$)

Parameter	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40 \sim 85^\circ\text{C}$		Unit	
			V_{CC}	Min.	Typ.	Max.	Min.		Max.
Output Transition Time	t_{TLH} t_{THL}	-	2.0	-	30	75	-	95	ns
			4.5	-	8	15	-	19	
			6.0	-	7	13	-	16	
Propagation Delay Time (A, B-Q, Q)	t_{PLH} t_{PHL}	-	2.0	-	102	210	-	265	ns
			4.5	-	29	42	-	53	
			6.0	-	22	36	-	45	
Propagation Delay Time (CE-Q, Q)	t_{PLH} t_{PHL}	-	2.0	-	68	160	-	200	ns
			4.5	-	20	32	-	40	
			6.0	-	16	27	-	34	
Output Pulse Width	t_{WOUT}	Cx = 28PF Rx = 6KΩ ($V_{CC} = 2\text{V}$) Rx = 2KΩ ($V_{CC} = 4.5\text{V}, 6\text{V}$)	2.0	-	700	2000	-	2500	ns
			4.5	-	250	400	-	500	
			6.0	-	210	340	-	425	
		Cx = 0.01μF Rx = 10KΩ	2.0	90	110	130	90	130	μs
			4.5	95	105	115	95	115	
			6.0	95	105	115	95	115	
		Cx = 0.1μF Rx = 10KΩ	2.0	0.9	1.0	1.2	0.9	1.2	ms
			4.5	0.9	1.0	1.1	0.9	1.1	
			6.0	0.9	1.0	1.1	0.9	1.1	
Output Pulse Width Error. Between Circuits (In same package)	Δt_{WOUT}	-	-	+1	-	-	-	%	
Input Capacitance	C_{IN}	-	-	5	10	-	10	pF	
Power Dissipation Capacitance	$C_{PD(1)}$	-	-	162	-	-	-		

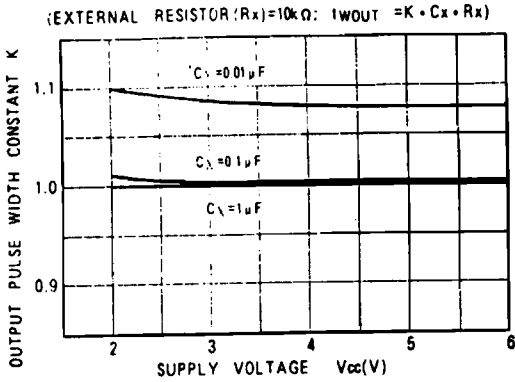
Note (1) C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

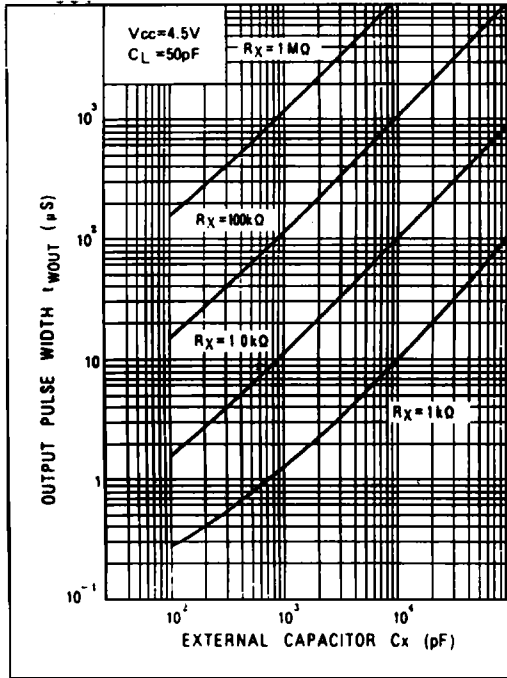
$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC'} \cdot \text{Duty}/100 + I_{CC}/2(\text{per circuit})$$

($I_{CC'}$: Active Supply Current)

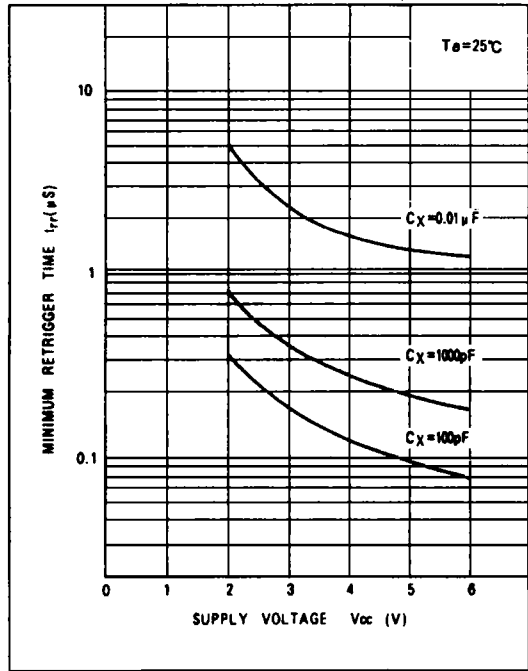
(Duty: %)



Output Pulse Width Constant K-Supply Voltage (Typical)



t_{WOUT}-C_x Characteristics (Typ.)



t_{Tr}-V_{cc} Characteristics (Typ.)