SGS-THOMSON MICROELECTRONICS

M54HC423
M74HC423

DUAL RETRIGGERABLE MONOSTABLE MULTIVIBRATORS

- **HIGH SPEED**
  t_{PD} = 28 ns (TYP) at V_{CC} = 5V
- **LOW POWER DISSIPATION**
  STANDBY STATE I_{CC} = 4 μA (MAX.) at T_A = 25°C
  ACTIVE STATE I_{CC} = 200 μA (TYP) at V_{CC} = 5V
- **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 mA (MIN.)
- **BALANCED PROPAGATION DELAYS**
  t_{PLH} = t_{PHL}
- **WIDE OPERATING VOLTAGE RANGE**
  V_{CC} (OPR) = 2V to 6V
- **PIN AND FUNCTION COMPATIBLE**
  WITH 54/74LS423
- **WIDE OUTPUT PULSE WIDTH RANGE**
  t_{WOUT} = 120ns to 60s over at V_{CC} = 4.5V

DESCRIPTION

The M54/74HC423 is a high speed CMOS MONO-STABLE multivibrator 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, A INPUT (negative edge) and 8 INPUT (positive edge). These inputs are valid for rising/falling signals, (t_r–t_f–l sec).
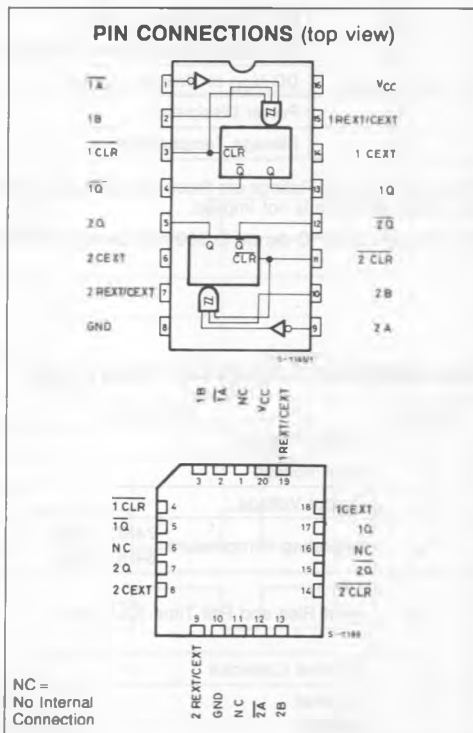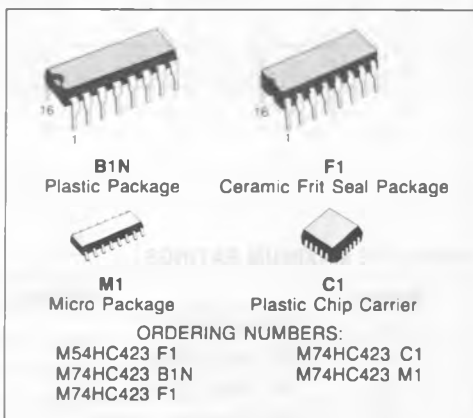
The device may also be triggered by using the CLR input (positive-edge) because of the Schmitt-trigger input; after triggering the output maintains the MO-NOSTABLE state for the time period determined by the external resistor Rx and capacitor Cx. Taking CLR low breaks this MONOSTABLE STATE. If the next trigger pulse occurs during the MONO-STABLE period it makes the MONOSTABLE period longer. Limit for values of Cx and Rx:

Cx : NO LIMIT

Rx : V_{CC} = 2.0V 5KΩ to 1MΩ
V_{CC} = 3.0V 1KΩ to 1MΩ

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

B1N
Plastic Package

F1
Ceramic Frit Seal Package

M1
Micro Package

C1
Plastic Chip Carrier

ORDERING NUMBERS:
M54HC423 F1   M74HC423 C1
M74HC423 B1N   M74HC423 M1
M74HC423 F1

PIN CONNECTIONS (top view)

NC = No Internal Connection

TRUTH TABLE

INPUTS			OUTPUTS		NOTE
$\overline{A}$	B	$\overline{CL}$	Q	$\overline{Q}$	
⟋	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

ABSOLUTE MAXIMUM RATINGS

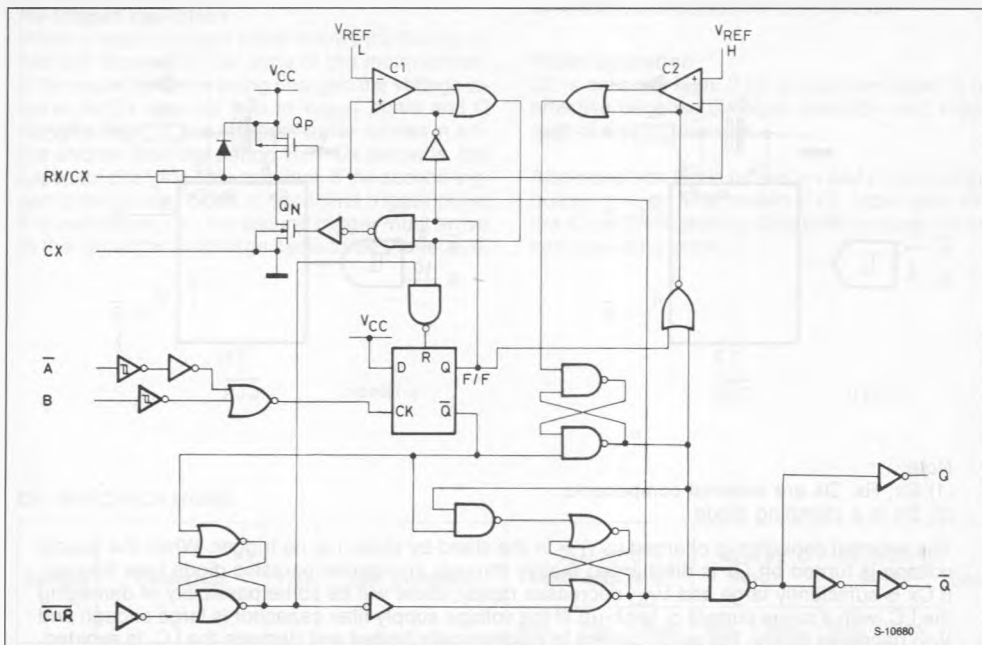| Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.5 to 7	V
V_I	DC Input Voltage	-0.5 to $V_{CC} + 0.5$	V
V_O	DC Output Voltage	-0.5 to $V_{CC} + 0.5$	V
I_{IK}	DC Input Diode Current	± 20	mA
I_{OK}	DC Output Diode Current	± 20	mA
I_O	DC Output Source Sink Current Per Output Pin	± 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 50	mA
P_D	Power Dissipation	500 (*)	mW
T_{stg}	Storage Temperature	-65 to 150	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

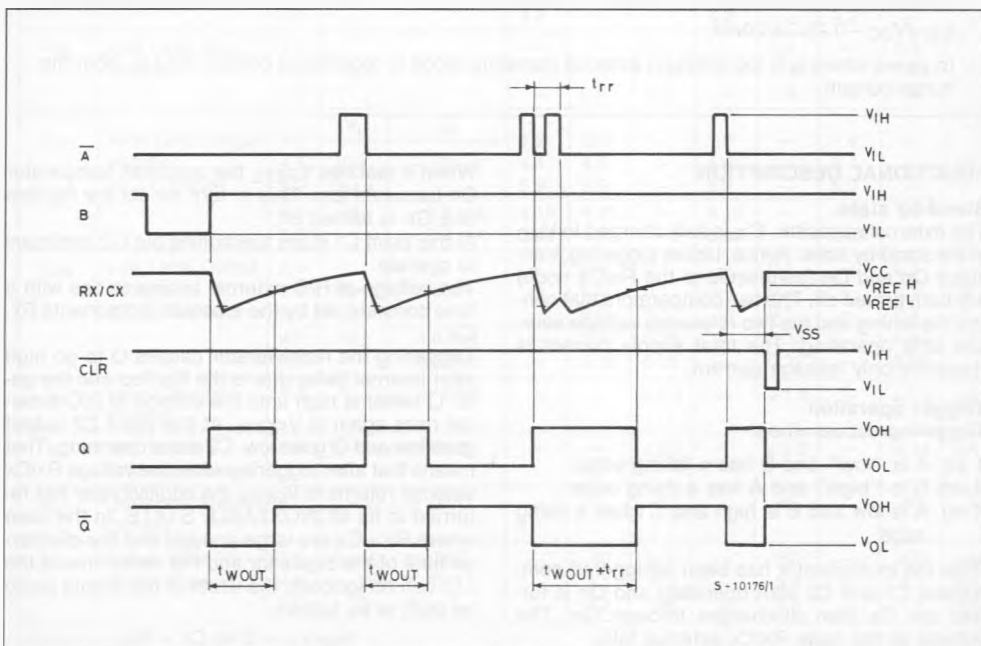(*) 500 mW: $\cong$ 65°C derate to 300 mW by 10 mW/°C: 65°C to 85°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Value		Unit
V_{CC}	Supply Voltage		2 to 6		V
V_I	Input Voltage		0 to V_{CC}		V
V_O	Output Voltage		0 to V_{CC}		V
T_A	Operating Temperature	74HC Series	-40 to 85		°C
		54HC Series	-55 to 125		
t_r, t_f	Input Rise and Fall Time ($\overline{CLR}$ only)	V_{CC}	2 V	0 to 1000	ns
			4.5V	0 to 500	
			6 V	0 to 400	
Cx	External Capacitor		NO LIMITATION		F
Rx	External Resistor	($V_{CC} = 2.0V$)	V_{CC} 2 V	5K to 1M	Ω
		($V_{CC} \geqq 3.0V$)	3 V	1K to 1M	

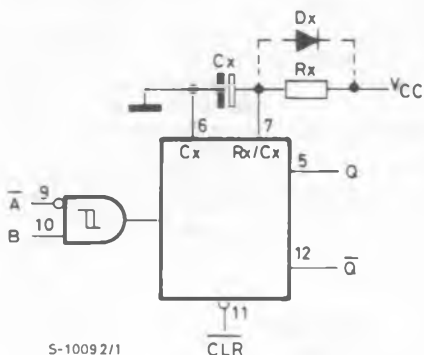**SGS-THOMSON**
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SYSTEM DIAGRAM

S-10680

TIMING CHART

S - 10176/1

BLOCK DIAGRAM
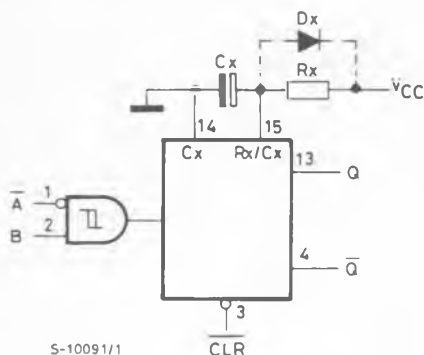
Note:
(1) Cx, Rx, Dx are external components.
(2) Dx is a clamping diode

The external capacitor is charged to V_{CC} in the stand-by state, i.e. no trigger. When the supply voltage is turned off Cx is discharged mainly through an internal parasitic diode (see figures). If Cx is sufficiently large and V_{CC} decreases rapidy, there will be some possibility of damaging the I.C. with a surge current or latch-up. If the voltage supply filter capacitor is large enough and V_{CC} decrease slowly, the surge current is automatically limited and damage the I.C. is avoided. The maximum forward current of the parasitic diode is approximately 20 mA. In cases where Cx is large the time taken for the supply voltage to fall to 0.4 V_{CC} can be calculated as follows:

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

In cases where t_f is too short an external clamping diode is required to protect the I.C. from the surge current.

FUNCTIONAL DESCRIPTION

Stand-by state
The external capacitor, Cx, is fully charged to V_{CC} in the stand-by state. Hence, before triggering, transistor Qp and Qn (connected to the Rx/Cx node) are both turned off. The two comparators that control the timing and the two reference voltage sources stop operating. The total supply current is therefore only leakage current.

Trigger operation
Triggering occurs when:

1 st) A is "low" and B has a falling edge;
2 nd) B is "high" and A has a rising edge;
3 rd) A is low and B is high and C1 has a rising edge.

After the multivibrator has been retriggered comparator C1 and C2 start operating and Qn is turned on. Cx then discharges through Qn. The voltage at the node Rx/Cx external falls.

When it reaches V_{REFL} the output of comparator C1 becomes low. This in turn resets the flip-flop and Gn is turned off.
At this point C1 stops functioning but C2 continues to operate.
The voltage at R/C external begins to rise with a time constant set by the external components Rx, Cx.
Triggering the multivibrator causes Q to go high after internal delay due to the flip-flop and the gate. Q remains high until the voltage at R/C external rises again to V_{REFH}. At this point C2 output goes low and O goes low. C2 stops operating. That means that after triggering when the voltage Rx/Cx external returns to V_{REFH} the equitivibrator has returned to its MONOSTABLE STATE. In the case where Rx • Cx are large enough and the discharge time of the capacitor and the delay time in the I.C. can be ignored, the width of the output pulse tw (out) is as follows:

$$t_{W(OUT)} = 0.46 \ Cx \cdot Rx$$

SGS-THOMSON
MICROELECTRONICS

FUNCTIONAL DESCRIPTION (Continued)

Re-trigger operation

When a second trigger pulse follows the first its effect will depend on the state of the multivibrator. If the capacitor Cx is being charged the voltage level of Rx/Cx external falls to V_{REFL} again and Q remains high i.e. the retrigger pulse arrives in a time shorter than the period Rx • Cx seconds, the capacitor charging time constant. If the second trigger pulse is very close to the initial trigger pulse it is ineffective; i.e., the second trigger must arrive in the capacitor discharge cycle to be ineffective.

Hence the minimum time for a second trigger to be effective depends on V_{CC} and C_x.

Reset operation

CL is normally high. If CL is low, the trigger is not effective because Q output goes low and trigger control flip-flop is reset.

Also transistor Op is turned on and Cx is charged quicky to V_{CC}. This means if CL input goes low, the IC becomes waiting state both in operating and non operating state.

DC SPECIFICATIONS

Symbol	Parameter	V_{CC}	Test Condition		$T_A = 25°C$ 54HC and 74HC			-40 to $85°C$ 74HC		-55 to $125°C$ 54HC		Unit
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V_{IH}	High Level Input Voltage	2.0			1.5	—	—	1.5	—	1.5	—	
		4.5			3.15	—	—	3.15	—	3.15	—	V
		6.0			4.2	—	—	4.2	—	4.2	—	
V_{IL}	Low Level Input Voltage	2.0			—	—	0.5	—	0.5	—	0.5	
		4.5			—	—	1.35	—	1.35	—	1.35	V
		6.0			—	—	1.8	—	1.8	—	1.8	
V_{OH}	High Level Output Voltage (Q, $\bar{Q}$ Output)	2.0	V_I	I_O	1.9	2.0	—	1.9	—	1.9	—	
		4.5	$V_I =$	$-20\,\mu A$	4.4	4.5	—	4.4	—	4.4	—	V
		6.0	$V_{IH} =$		5.9	6.0	—	5.9	—	5.9	—	
		4.5	V_{IL}	-4.0 mA	4.18	4.31	—	4.13	—	4.10	—	
		6.0		-5.2 mA	5.68	5.8	—	5.63	—	5.60	—	
V_{OL}	Low Level Output Voltage (Q, $\bar{Q}$ Output)	2.0	$V_I =$	$20\,\mu A$	—	0.0	0.1	—	0.1	—	0.1	
		4.5	$V_{IH} =$		—	0.0	0.1	—	0.1	—	0.1	V
		6.0	V_{IL}		—	0.0	0.1	—	0.1	—	0.1	
		4.5		4.0 mA	—	0.17	0.26	—	0.33	—	0.40	
		6.0		5.2 mA	—	0.18	0.26	—	0.33	—	0.40	
I_{IN}	Input Leakage Current	6.0	$V_I = V_{CC}$ or GND		—	—	± 0.1	—	± 1.0	—	± 1.0	μA
I_{IN}	R/C Terminal Off-State Current	6.0	$V_I = V_{CC}$ or GND		—	—	± 0.5	—	± 5.0	—	± 10	μA
I_{CC}	Quiescent Supply Current	6.0	$V_I = V_{CC}$ or GND		—	—	4	—	40	—	80	μA
I_{CC}	Active State (1) Supply Current	2.0	$V_I = V_{CC}$ or GND		—	40	120	—	160	—	200	μA
		4.5	pins 7, 15		—	0.1	0.3	—	0.4	—	0.5	mA
		6.0	$V_{IN} = V_{CC/2}$		—	0.2	0.6	—	0.8	—	1.0	mA

(1) Per circuit

AC ELECTRICAL CHARACTERISTICS (V_{CC} = 5V, T_A = 25°C, C_L = 15pF, Input t_r = t_f = 6ns)

Symbol	Parameter	54HC and 74HC			Unit
		Min.	Typ.	Max.	
t_{TLH} t_{THL}	Output Transition Time		4	8	ns
t_{PLH} t_{PHL}	Propagation Delay Time ($\overline{A}$,B - Q,$\overline{Q}$)		27	41	ns
t_{PLH} t_{PHL}	Propagation Delay Time ($\overline{CLEAR}$ - Q,$\overline{Q}$)		21	33	ns

AC ELECTRICAL CHARACTERISTICS (C_L = 50pF, Input t_r = t_f = 6ns)

Symbol	Parameter	V_{CC}	Test Condition	T_A = 25°C 54HC and 74HC			− 40 to 85°C 74HC		− 55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{TLH} t_{THL}	Output Transition Time	2.0 4.5 6.0		— — —	30 8 7	75 15 13	— — —	95 19 16	— —	110 22 19	ns
t_{PLH} t_{PHL}	Propagation Delay Time ($\overline{A}$, B - Q, $\overline{Q}$)	2.0 4.5 6.0		— — —	124 31 26	240 48 41	— — —	300 60 51	—	360 72 61	ns
t_{PLH} t_{PHL}	Propagation Delay Time ($\overline{CLEAR}$ - Q, $\overline{Q}$)	2.0 4.5 6.0		— — —	100 25 21	195 39 33	— — —	245 49 42		295 59 50	ns
$t_{W(H)}$ $t_{W(L)}$	Minimum Pulse Width ($\overline{A}$, B)	2.0 4.5 6.0		— — —	30 8 7	75 15 13	— — —	95 19 16	— — —	110 22 19	ns
$t_{W(L)}$	Minimum Clear Pulse Width	2.0 4.5 6.0		— — —	30 8 7	75 15 13	— — —	95 19 16		110 22 19	ns
t_{REM}	Minimum Clear Removal Time	2.0 4.5 6.0		— — —	— — —	0 0 0	— — —	0 0 0	— — —	0 0 0	ns
Δt_{WOUT}	Output Pulse Width Error Between Circuits in same Package			—	± 1	—	—	—	—	—	%
t_{rr}	Minimum Retrigger Time	4.5 6.0	Cx = 100pF Rx = 1kΩ	— —	74 63	— —	— —	— —	— —	— —	ns
		4.5 6.0	Cx = 0.01μF Rx = 1kΩ	— —	1.1 1.0	— —	— —	— —	— —	— —	μs
t_{WOUT} (MIN)	Minimum output Pulse Width	4.5	Cx = 0 Rx = 1kΩ	—	118	—	—	—	—	—	ns

AC ELECTRICAL CHARACTERISTICS (Continued)

Symbol	Parameter	V_{CC}	Test Condition	T_A = 25°C 54HC and 74HC			− 40 to 85°C 74HC		− 55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{WOUT}	Output Pulse Width	4.5	Cx = 100pF Rx = 10kΩ	—	1.0	—	—	—	—	—	μS
	Width	4.5	Cx = 0.1μF R_x = 100kΩ	—	4.7	—	—	—	—	—	ms
C_{IN}	Input Capacitance			—	5	10	—	10		10	pF
$C_{PD(°)}$	Power Dissipation Capacitance			—	113	—	—	—	—	—	pF

Note (°) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load (refer to Test Circuit).
Average operating current can be obtained by the equation hereunder.
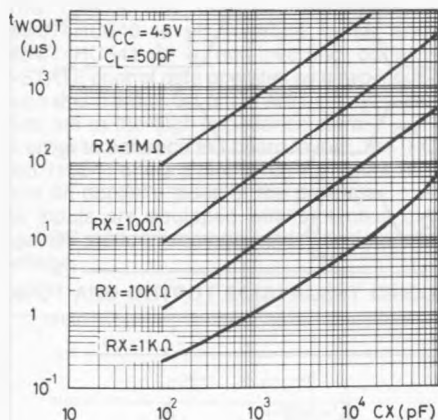$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}' \cdot Duty/100/ + I_{CC}/2$ (per monostable)

(I_{CC}': Active Supply Current)

(Duty: %)

t_{WOUT} - Cx Characteristics (Typ.)

t_{rr} - V_{CC} Characteristics (Typ).

Output Pulse Width Constant,
K-Supply Voltage

G-6369

TEST CIRCUIT I$_{CC}$ (Opr.)

TRANSITION TIME OF INPUT WAVEFORM IS THE
SAME AS THAT IN CASE OF SWITCHING
CHARACTERISTICS TEST

SWITCHING CHARACTERISTICS TEST WAVEFORM

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