

# CD74HC123, CD74HCT123, CD74HC423, CD74HCT423

## High Speed CMOS Logic Dual Retriggerable Monostable Multivibrators with Resets

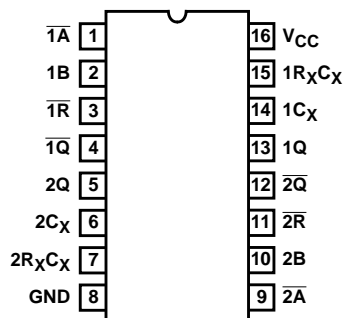
September 1997

### Features

- Overriding Reset Terminates Output Pulse
- Triggering From the Leading or Trailing Edge
- Q and  $\bar{Q}$  Buffered Outputs
- Separate Resets
- Wide Range of Output-Pulse Widths
- Schmitt Trigger on Both  $\bar{A}$  and B Inputs
- Fanout (Over Temperature Range)
  - Standard Outputs . . . . . 10 LSTTL Loads
  - Bus Driver Outputs . . . . . 15 LSTTL Loads
- Wide Operating Temperature Range . . . -55°C to 125°C
- Balanced Propagation Delay and Transition Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- HC Types
  - 2V to 6V Operation
  - High Noise Immunity:  $N_{IL} = 30\%$ ,  $N_{IH} = 30\%$  of  $V_{CC}$  at  $V_{CC} = 5V$
- HCT Types
  - 4.5V to 5.5V Operation
  - Direct LSTTL Input Logic Compatibility,  $V_{IL} = 0.8V$  (Max),  $V_{IH} = 2V$  (Min)
  - CMOS Input Compatibility,  $I_I \leq 1\mu A$  at  $V_{OL}$ ,  $V_{OH}$

### Pinout

CD74HC123, CD74HCT123, CD74HC423, CD74HCT423  
(PDIP, SOIC)  
TOP VIEW



### Description

The Harris CD74HC123, CD74HCT123, CD74HC423 and CD74HCT423 are dual monostable multivibrators with resets. They are all retriggerable and differ only in that the 123 types can be triggered by a negative to positive reset pulse; whereas the 423 types do not have this feature. An external resistor ( $R_X$ ) and an external capacitor ( $C_X$ ) control the timing and the accuracy for the circuit. Adjustment of  $R_X$  and  $C_X$  provides a wide range of output pulse widths from the Q and  $\bar{Q}$  terminals. Pulse triggering on the  $\bar{A}$  and B inputs occur at a particular voltage level and is not related to the rise and fall times of the trigger pulses.

Once triggered, the output pulse width may be extended by retriggering inputs  $\bar{A}$  and B. The output pulse can be terminated by a LOW level on the Reset (R) pin. Trailing edge triggering ( $\bar{A}$ ) and leading edge triggering (B) inputs are provided for triggering from either edge of the input pulse. If either Mono is not used each input on the unused device ( $\bar{A}$ , B, and  $\bar{R}$ ) must be terminated high or low.

The minimum value of external resistance,  $R_X$  is typically  $5k\Omega$ . The minimum value external capacitance,  $C_X$ , is 0pF. The calculation for the pulse width is  $t_W = 0.45 R_X C_X$  at  $V_{CC} = 5V$ .

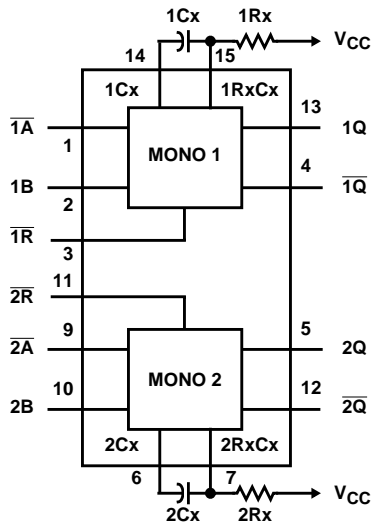
### Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
CD74HC123E	-55 to 125	16 Ld PDIP	E16.3
CD74HCT123E	-55 to 125	16 Ld PDIP	E16.3
CD74HC423E	-55 to 125	16 Ld PDIP	E16.3
CD74HCT423E	-55 to 125	16 Ld PDIP	E16.3
CD74HC123M	-55 to 125	16 Ld SOIC	M16.15
CD74HCT123M	-55 to 125	16 Ld SOIC	M16.15
CD74HC423M	-55 to 125	16 Ld SOIC	M16.15
CD74HCT423M	-55 to 125	16 Ld SOIC	M16.15

#### NOTES:

1. When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.
2. Wafer or die for this part number is available which meets all electrical specifications. Please contact your local sales office or Harris customer service for ordering information.

Functional Diagram



TRUTH TABLE

INPUTS			OUTPUTS	
$\bar{A}$	B	$\bar{R}$	Q	$\bar{Q}$
<b>CD74HC/HCT123</b>				
H	X	H	L	H
X	L	H	L	H
L	↑	H	⌋	⌋
↓	H	H	⌋	⌋
X	X	L	L	H
L	H	↑	⌋	⌋
<b>CD74HC/HCT423</b>				
H	X	H	L	H
X	L	H	L	H
L	↑	H	⌋	⌋
↓	H	H	⌋	⌋
X	X	L	L	H

NOTE: H = High Voltage Level, L = Low Voltage Level,  
X = Don't Care.

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### Absolute Maximum Ratings

DC Supply Voltage, $V_{CC}$ .....	-0.5V to 7V
DC Input Diode Current, $I_{IK}$	
For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$ .....	$\pm 20mA$
DC Output Diode Current, $I_{OK}$	
For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$ .....	$\pm 20mA$
DC Output Source or Sink Current per Output Pin, $I_O$	
For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$ .....	$\pm 25mA$
DC $V_{CC}$ or Ground Current, $I_{CC}$ or $I_{GND}$ .....	$\pm 50mA$

### Thermal Information

Thermal Resistance (Typical, Note 3)	$\theta_{JA}$ (°C/W)
PDIP Package .....	90
SOIC Package .....	115
Maximum Junction Temperature .....	150°C
Maximum Storage Temperature Range .....	-65°C to 150°C
Maximum Lead Temperature (Soldering 10s) .....	300°C (SOIC - Lead Tips Only)

### Operating Conditions

Temperature Range ( $T_A$ ) .....	-55°C to 125°C
Supply Voltage Range, $V_{CC}$	
HC Types .....	.2V to 6V
HCT Types .....	.4.5V to 5.5V
DC Input or Output Voltage, $V_I$ , $V_O$ .....	0V to $V_{CC}$
Input Rise and Fall Time	
2V .....	1000ns (Max)
4.5V .....	500ns (Max)
6V .....	400ns (Max)

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

#### NOTE:

- $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.

### DC Electrical Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		$V_{CC}$ (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		$V_I$ (V)	$I_O$ (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX	
<b>HC TYPES</b>												
High Level Input Voltage	$V_{IH}$	-	-	2	1.5	-	-	1.5	-	1.5	-	V
				4.5	3.15	-	-	3.15	-	3.15	-	V
				6	4.2	-	-	4.2	-	4.2	-	V
Low Level Input Voltage	$V_{IL}$	-	-	2	-	-	0.5	-	0.5	-	0.5	V
				4.5	-	-	1.35	-	1.35	-	1.35	V
				6	-	-	1.8	-	1.8	-	1.8	V
High Level Output Voltage CMOS Loads	$V_{OH}$	$V_{IH}$ or $V_{IL}$	-0.02	2	1.9	-	-	1.9	-	1.9	-	V
			-0.02	4.5	4.4	-	-	4.4	-	4.4	-	V
			-0.02	6	5.9	-	-	5.9	-	5.9	-	V
High Level Output Voltage TTL Loads	$V_{OH}$	$V_{IH}$ or $V_{IL}$	-	-	-	-	-	-	-	-	-	V
			-4	4.5	3.98	-	-	3.84	-	3.7	-	V
			-5.2	6	5.48	-	-	5.34	-	5.2	-	V
Low Level Output Voltage CMOS Loads	$V_{OL}$	$V_{IH}$ or $V_{IL}$	0.02	2	-	-	0.1	-	0.1	-	0.1	V
			0.02	4.5	-	-	0.1	-	0.1	-	0.1	V
			0.02	6	-	-	0.1	-	0.1	-	0.1	V
Low Level Output Voltage TTL Loads	$V_{OL}$	$V_{IH}$ or $V_{IL}$	-	-	-	-	-	-	-	-	-	V
			4	4.5	-	-	0.26	-	0.33	-	0.4	V
			5.2	6	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	$I_I$	$V_{CC}$ or GND	-	6	-	-	$\pm 0.1$	-	$\pm 1$	-	$\pm 1$	$\mu A$
Quiescent Device Current	$I_{CC}$	$V_{CC}$ or GND	0	6	-	-	8	-	80	-	160	$\mu A$

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**DC Electrical Specifications (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS		V <sub>CC</sub> (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		V <sub>I</sub> (V)	I <sub>O</sub> (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX	
<b>HCT TYPES</b>												
High Level Input Voltage	V <sub>IH</sub>	-	-	4.5 to 5.5	2	-	-	2	-	2	-	V
Low Level Input Voltage	V <sub>IL</sub>	-	-	4.5 to 5.5	-	-	0.8	-	0.8	-	0.8	V
High Level Output Voltage CMOS Loads	V <sub>OH</sub>	V <sub>IH</sub> or V <sub>IL</sub>	-0.02	4.5	4.4	-	-	4.4	-	4.4	-	V
High Level Output Voltage TTL Loads			-4	4.5	3.98	-	-	3.84	-	3.7	-	V
Low Level Output Voltage CMOS Loads	V <sub>OL</sub>	V <sub>IH</sub> or V <sub>IL</sub>	0.02	4.5	-	-	0.1	-	0.1	-	0.1	V
Low Level Output Voltage TTL Loads			4	4.5	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	I <sub>I</sub>	V <sub>CC</sub> and GND	0	5.5	-	-	±0.1	-	±1	-	±1	μA
Quiescent Device Current	I <sub>CC</sub>	V <sub>CC</sub> or GND	0	5.5	-	-	8	-	80	-	160	μA
Additional Quiescent Device Current Per Input Pin: 1 Unit Load	ΔI <sub>CC</sub>	V <sub>CC</sub> -2.1	-	4.5 to 5.5	-	100	360	-	450	-	490	μA

NOTE: For dual-supply systems theoretical worst case (V<sub>I</sub> = 2.4V, V<sub>CC</sub> = 5.5V) specification is 1.8mA.

**HCT Input Loading Table**

INPUT	UNIT LOADS
All	0.35

NOTE: Unit Load is ΔI<sub>CC</sub> limit specified in DC Electrical Table, e.g. 360μA max at 25°C.

**Prerequisite for Switching Specifications**

PARAMETER	SYMBOL	V <sub>CC</sub> (V)	25°C			-40°C TO 85°C			-55°C TO 125°C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
<b>HC TYPES</b>												
Minimum Input, Pulse Width A	t <sub>WL</sub>	2	100	-	-	125	-	-	150	-	-	ns
		4.5	20	-	-	25	-	-	30	-	-	ns
		6	17	-	-	21	-	-	26	-	-	ns
B	t <sub>WH</sub>	2	100	-	-	125	-	-	150	-	-	ns
		4.5	20	-	-	25	-	-	30	-	-	ns
		6	17	-	-	21	-	-	26	-	-	ns

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**Prerequisite for Switching Specifications (Continued)**

PARAMETER	SYMBOL	V <sub>CC</sub> (V)	25°C			-40°C TO 85°C			-55°C TO 125°C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$\bar{R}$	t <sub>WL</sub>	2	100	-	-	125	-	-	150	-	150	ns
		4.5	20	-	-	25	-	-	30	-	30	ns
		6	17	-	-	21	-	-	26	-	26	ns
$\bar{A}$ and B Hold Time	t <sub>H</sub>	2	50	-	-	65	-	-	75	-	75	ns
		4.5	10	-	-	13	-	-	15	-	15	ns
		6	9	-	-	11	-	-	13	-	13	ns
Reset Removal Time	t <sub>REM</sub>	2	50	-	-	65	-	-	75	-	75	ns
		4.5	10	-	-	13	-	-	15	-	15	ns
		6	9	-	-	11	-	-	13	-	13	ns
Retrigger Time Number R <sub>X</sub> = 10KΩ, C <sub>X</sub> = 0	t <sub>rT</sub>	5	-	-	-	-	-	-	-	-	-	ns
			-	50	-	-	63	-	-	76	-	ns
Output Pulse Width Q or $\bar{Q}$ R <sub>X</sub> = 10KΩ, C <sub>X</sub> = 10nF	t <sub>W</sub>	5	40	-	50	38.7	-	51.3	38.2	-	51.8	μs
<b>HCT TYPES</b>												
Minimum Input, Pulse Width $\bar{A}$	t <sub>WL</sub>	5	20	-	-	25	-	-	30	-	-	ns
			B	t <sub>WH</sub>	20	-	-	25	-	-	30	-
$\bar{R}$	t <sub>WL</sub>	5	20	-	-	25	-	-	30	-	-	ns
$\bar{A}$ and B Hold Time	t <sub>H</sub>	5	10	-	-	13	-	-	15	-	-	ns
Reset Removal Time	t <sub>REM</sub>	5	10	-	-	13	-	-	15	-	-	ns
Retrigger Time Number (Note 4) R <sub>X</sub> = 10KΩ, C <sub>X</sub> = 0	t <sub>rT</sub>	5	-	50	-	-	63	-	-	76	-	ns
Output Pulse Width Q or $\bar{Q}$ R <sub>X</sub> = 10KΩ, C <sub>X</sub> = 10nF	t <sub>W</sub>	5	40	-	50	38.7	-	51.3	38.2	-	51.8	μs

**NOTE:**

- Time to trigger depends on the values of R<sub>X</sub> and C<sub>X</sub>. The output pulse width can only be extended when the time between the active-going edges of the trigger input pulses meet the minimum retrigger time requirement.

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**Switching Specifications**  $C_L = 50\text{pF}$ , Input  $t_r, t_f = 6\text{ns}$ ,  $R_X = 10\text{K}\Omega$ ,  $C_X = 0$

PARAMETER	SYMBOL	TEST CONDITIONS	$V_{CC}$ (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
<b>HC TYPES</b>											
Trigger Propagation Delay $\bar{A}, B, \bar{R}$ to Q	$t_{PHL}$	$C_L = 50\text{pF}$	2	-	-	300	-	375	-	450	ns
			4.5	-	-	60	-	75	-	90	ns
		$C_L = 15\text{pF}$	5	-	25	-	-	-	-	-	ns
		$C_L = 50\text{pF}$	6	-	-	51	-	64	-	76	ns
$\bar{A}, B, \bar{R}$ to $\bar{Q}$	$t_{PHL}$	$C_L = 50\text{pF}$	2	-	-	320	-	400	-	480	ns
			4.5	-	-	64	-	80	-	96	ns
		$C_L = 15\text{pF}$	5	-	26	-	-	-	-	-	ns
		$C_L = 50\text{pF}$	6	-	-	54	-	68	-	82	ns
Reset Propagation Delay $\bar{R}$ to Q or $\bar{Q}$	$t_{PHL}, t_{PLH}$	$C_L = 50\text{pF}$	2	-	-	215	-	270	-	325	ns
			4.5	-	-	43	-	54	-	65	ns
			6	-	-	37	-	46	-	55	ns
Output Transition Time	$t_{THL}, t_{TLH}$	$C_L = 50\text{pF}$	2	-	-	75	-	95	-	110	ns
			4.5	-	-	15	-	19	-	22	ns
			6	-	-	13	-	16	-	19	ns
Output Pulse Width $R_X = 10\text{K}\Omega, C_X = 10\text{pF}$	-	-	5	-	45	-	-	-	-	$\mu\text{s}$	
Pulse Width Match Between Circuits In the Same Package $R_X = 10\text{K}\Omega, C_X = 10\text{pF}$	-	-	5	-	$\pm 2$	-	-	-	-	%	
Power Dissipation Capacitance	$C_{PD}$	$C_L = 15\text{pF}$	5	-	-	-	-	-	-	-	pF
Input Capacitance	$C_{IN}$	$C_L = 50\text{pF}$	-	10	-	10	-	10	-	10	pF

**NOTES:**

- $C_{PD}$  is used to determine the dynamic power consumption, per multivibrator.
- $P_D = (C_{PD} + C_X) V_{CC}^2 f_i \sum (C_L V_{CC}^2 f_O)$  where  $f_i$  = input frequency,  $f_O$  = Output Frequency,  $C_L$  = Output Load Capacitance,  $C_X$  = External Capacitance  $V_{CC}$  = Supply Voltage assuming  $f_i \ll \frac{1}{t_W}$

Test Circuits and Waveforms

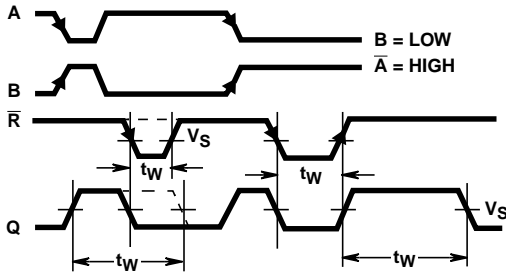


FIGURE 1. OUTPUT PULSE CONTROL USING RESET INPUT (R) PULSE FOR 123

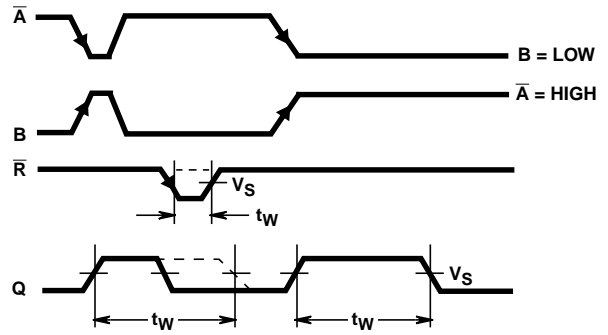
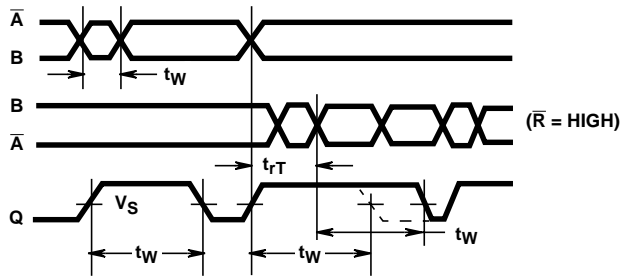


FIGURE 2. OUTPUT PULSE CONTROL USING RESET INPUT (R) FOR 423



NOTE: Output pulse control using retrigger pulse for 123 and 423.

FIGURE 3. TRIGGERING OF ONE SHOT BY INPUT  $\bar{A}$  OR INPUT B FOR A PERIOD  $t_w$

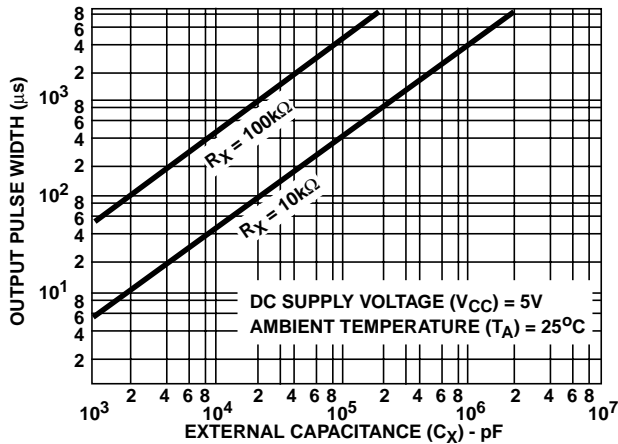


FIGURE 4. TYPICAL OUTPUT PULSE WIDTH AS A FUNCTION OF  $C_x$  FOR  $R_x = 10k\Omega$  AND  $100k\Omega$

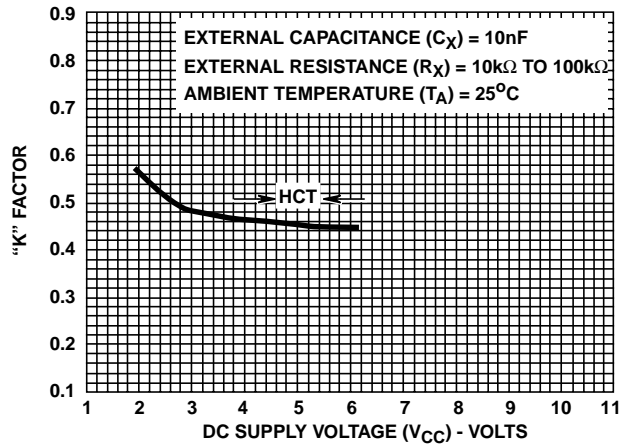


FIGURE 5. TYPICAL "K" FACTOR AS A FUNCTION OF  $V_{CC}$