National Semiconductor

DM54123/DM74123 Dual Retriggerable One-Shot with Clear and Complementary Outputs

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General Description

The '123 is a dual retriggerable monostable multivibrator capable of generating output pulses from a few nano-seconds to extremely long duration up to 100% duty cycle. Each device has three inputs permitting the choice of either leading-edge or trailing edge triggering. Pin (A) is an active-low transition trigger input and pin (B) is an active-high transition trigger input. A low at the clear (CLR) input terminates the output pulse: which also inhibits triggering. An internal connection from CLR to the input gate makes it possible to trigger the circuit by a positive-going signal on CLR as shown in the truth table.

To obtain the best and trouble free operation from this device please read the operating rules as well as the NSC one−shot application notes carefully and observe recommendations.

Features

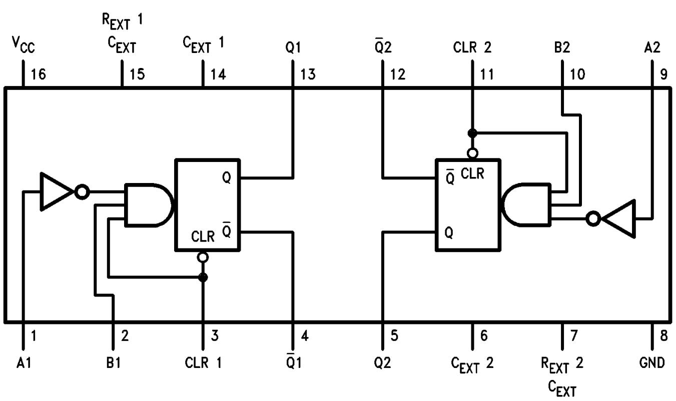
- DC triggered from active-high transition or active-low transition inputs
- Retriggerable to 100% duty cycle
- Direct reset terminates output pulse
- Compensated for V_{CC} and temperature variations
- DTL, TTL compatible
- Input clamp diodes

Functional Description

The basic output pulse width is determined by selection of an external resistor (R_X) and capacitor (C_X). Once triggered, the basic pulse width may be extended by retriggering the gated active-low transition or active-high transition inputs or be reduced by use of the active-low transition clear input. Retriggering to 100% duty cycle is possible by application of an input pulse train whose cycle time is shorter than the output cycle time such that a continuous "HIGH" logic state is maintained at the "Q" output.

Connection Diagram

Dual-In-Line Package



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Order Number DM54123J-MIL, DM54123W-MIL or DM74123N
See NS Package Number J16A, N16A or W16A

Triggering Truth Table

Inputs			Response
A	B	CLR	
X	X	L	No Trigger
↓	L	X	No Trigger
↓	H	H	Trigger
H	↑	X	No Trigger
L	↑	H	Trigger
L	H	↑	Trigger

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

 TL/F/6539 RRD-B30M105/Printed in U. S. A.

Absolute Maximum Ratings (Note)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage	7V
Input Voltage	5.5V
Operating Free Air Temperature Range	
DM54	−55°C to +100°C
DM74	0°C to +70°C
Storage Temperature	−65°C to +150°C

Note: *The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.*

Recommended Operating Conditions

Symbol	Parameter		DM54123			DM74123			Units
			Min	Nom	Max	Min	Nom	Max	
V_{CC}	Supply Voltage		4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High Level Input Voltage		2			2			V
V_{IL}	Low Level Input Voltage				0.8			0.8	V
I_{OH}	High Level Output Current				−0.8			−0.8	mA
I_{OL}	Low Level Output Current				16			16	mA
t_W	Pulse Width (Note 5)	A or B High				40			ns
		A or B Low				40			
		Clear Low				40			
T_{WQ} (Min)	Minimum Width of Pulse at Q (Note 5)	A or B			80			65	ns
R_{EXT}	External Timing Resistor					5		50	kΩ
C_{EXT}	External Timing Capacitance					No Restriction			µF
C_{WIRE}	Wiring Capacitance at R_{EXT}/C_{EXT} Terminal (Note 5)							50	pF
T_A	Free Air Operating Temperature		−55		125	0		70	°C

Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions		Min	Typ (Note 1)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −12 mA				−1.5	V
V_{OH}	High Level Output Voltage	V_{CC} = Min, I_{OH} = Max	DM54	2.4	3.4		V
		V_{IL} = Max, V_{IH} = Min	DM74	2.5			
V_{OL}	Low Level Output Voltage	V_{CC} = Min, I_{OL} = Max V_{IH} = Min, V_{IL} = Max			0.2	0.4	V
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 5.5V				1	mA
I_{IH}	High Level Input Current	V_{CC} = Max V_I = 2.4V	Data			40	µA
			Clear			80	
I_{IL}	Low Level Input Current	V_{CC} = Max, V_I = 0.4V	Clear			−3.2	mA
			Data			−1.6	
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 2)	DM54	−10		−40	mA
			DM74	−10		−40	
I_{CC}	Supply Current	V_{CC} = Max (Notes 3 and 4)			46	66	mA

Note 1: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 2: Not more than one output should be shorted at a time.

Note 3: Quiescent I_{CC} is measured (after clearing) with 2.4V applied to all clear and A inputs, B inputs grounded, all outputs open, C_{EXT} = 0.02 µF, and R_{EXT} = 25 KΩ.

Note 4: I_{CC} is measured in the triggered state with 2.4V applied to all clear and B inputs, A inputs grounded, all outputs open, C_{EXT} = 0.02 µF, and R_{EXT} = 25 kΩ.

Note 5: T_A = 25°C and V_{CC} = 5V.

Switching Characteristics at $V_{CC} = 5V$ and $T_A = 25°C$

Symbol	Parameter	From (Input) To (Output)	DM54123 $C_L = 15$ pF, $R_L = 400\Omega$ $C_{EXT} = 0$ pF, $R_{EXT} = 5$ kΩ		DM74123 $C_L = 15$ pF, $R_L = 400\Omega$ $C_{EXT} = 1000$ pF, $R_{EXT} = 10$ KΩ		Units
			Min	Max	Min	Max	
t_{PLH}	Propagation Delay Time Low to High Level Output	$\overline{A}$ to Q		33		33	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	B to Q		28		28	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	$\overline{A}$ to $\overline{Q}$		40		40	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	B to $\overline{Q}$		36		36	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	Clear to $\overline{Q}$		40		40	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	$\overline{\text{Clear}}$ to Q		27		27	ns
$t_{W(out)}$	Output Pulse Width*	A or B to Q	3.08	3.76	3.08	3.76	μs

*$C_{ECT} = 1000$ pF, $R_{EXT} = 10$ kΩ

Operating Rules

1. An external resistor (R_X) and external capacitor (C_X) are required for proper operation. The value of C_X may vary from 0 to any necessary value. For small time constants high-grade mica, glass, polypropylene, polycarbonate, or polystyrene material capacitors may be used. For large time constants use tantalum or special aluminum capacitors. If the timing capacitors have leakages approaching 100 nA or if stray capacitance from either terminal to ground is greater than 50 pF the timing equations may not represent the pulse width the device generates.
2. When an electrolytic capacitor is used for C_X a switching diode is often required for standard TTL one-shots to prevent high inverse leakage current *(Figure 1).* However, its use in general is not recommended with retriggerable operation.
3. The output pulse width (T_W) for $C_X > 1000$ pF is defined as follows:

   $T_W = K R_X C_X (1 + 0.7/R_X)$

   where [R_X is in Kilo-ohm]

   [C_X is in pico Farad]

   [T_W is in nano second]

   [$K \approx 0.28$]

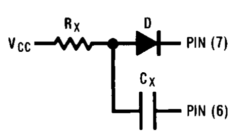

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FIGURE 1

4. For $C_X < 1000$ pF see *Figure 2* for T_W vs C_X family curves with R_X as a parameter:

Pulse Width vs R_X and C_X

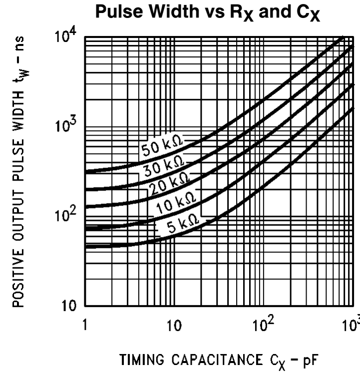

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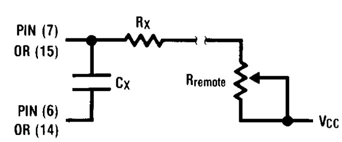
FIGURE 2

5. To obtain variable pulse width by remote trimming, the following circuit is recommended:



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Note: "R_{remote}" should be as close to the one-shot as possible.

FIGURE 3

Operating Rules (Continued)

6. The retriggerable pulse width is calculated as shown below:

   $$T = T_W + t_{PLH} = K \times R_X \times C_X + t_{PLH}$$

   The retriggered pulse width is equal to the pulse width plus a delay time period *(Figure 4).*

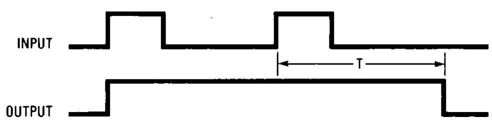

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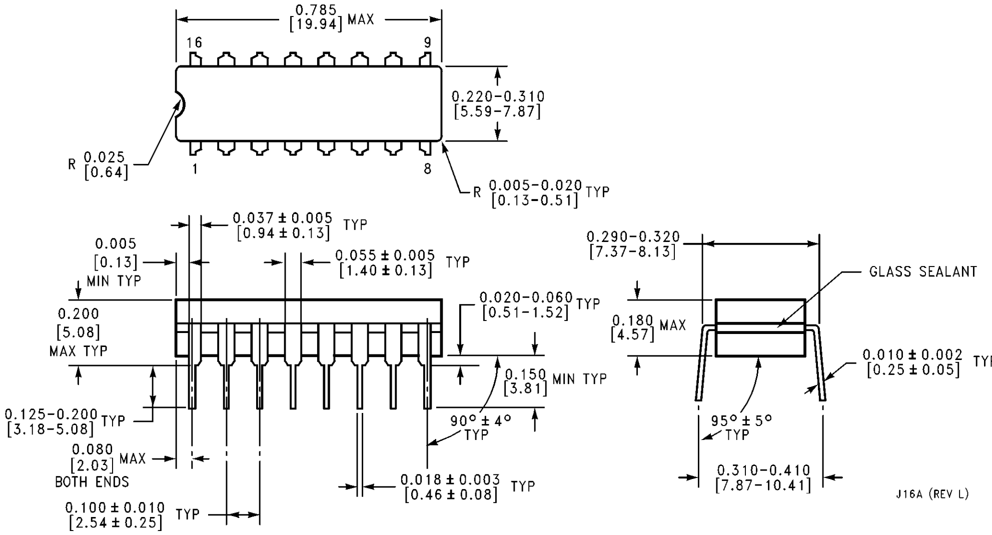
FIGURE 4

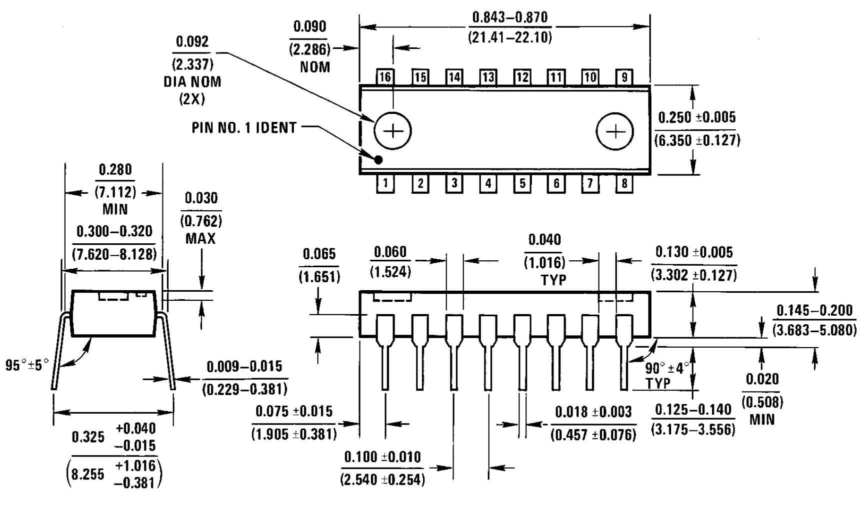
7. Under any operating condition C_X and R_X must be kept as close to the one-shot device pins as possible to minimize stray capacitance, to reduce noise pick-up, and to reduce $I \times R$ and Ldi/dt voltage developed along their connecting paths. If the lead length from C_X to pins (6) and (7) or pins (14) and (15) is greater than 3 cm, for example, the output pulse width might be quite different from values predicted from the appropriate equations. A non-inductive and low capacitive path is necessary to ensure complete discharge of C_X in each cycle of its operation so that the output pulse width will be accurate.
8. V_{CC} and ground wiring should conform to good high-frequency standards and practices so that switching transients on the V_{CC} and ground return leads do not cause interaction between one-shots. A 0.01 μF to 0.10 μF bypass capacitor (disk ceramic or monolithic type) from V_{CC} to ground is necessary on each device. Furthermore, the bypass capacitor should be located as close to the V_{CC} pin as space permits.

***For further detailed device characteristics and output performance please refer to the NSC one-shot application note, AN-366.**

Physical Dimensions inches (millimeters)

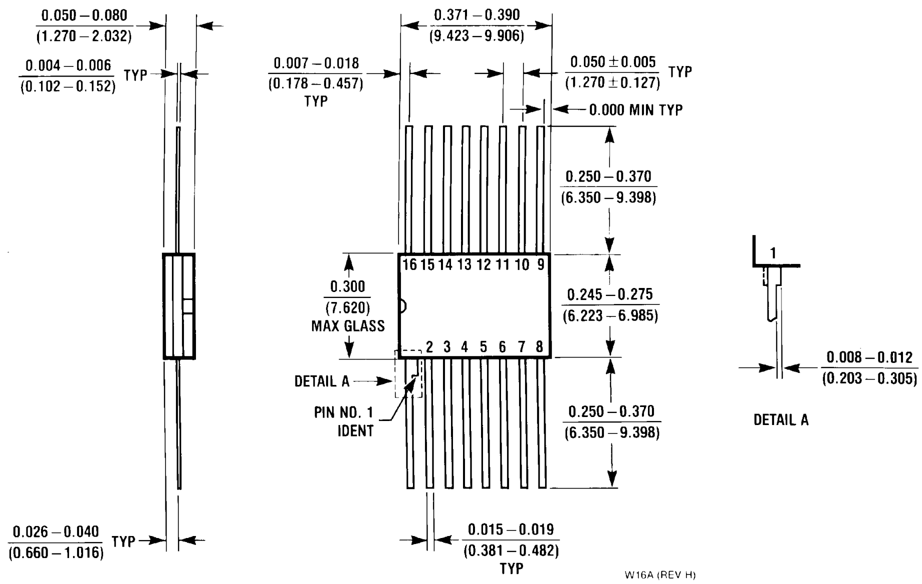


Ceramic Dual-In-Line Package (J)
Order Number DM54123J-MIL
NS Package Number J16A



Molded Dual-In-Line Package (N)
Order Number DM74123N
NS Package Number N16A

Physical Dimensions inches (millimeters) (Continued)



16-Lead Ceramic Flat Package (W)
Order Number DM54123W-MIL
NS Package Number W16A

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