

T-51-19

## CD4098B Types

### CMOS Dual Monostable Multivibrator

High-Voltage Types (20-Volt Rating)

The RCA-CD4098B dual monostable multivibrator provides stable retriggerable/resettable one-shot operation for any fixed-voltage timing application.

An external resistor ( $R_X$ ) and an external capacitor ( $C_X$ ) control the timing 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. The time delay from trigger input to output transition (trigger propagation delay) and the time delay from reset input to output transition (reset propagation delay) are independent of  $R_X$  and  $C_X$ .

Leading-edge-triggering (+TR) and trailing-edge-triggering (-TR) inputs are provided for triggering from either edge of an input pulse. An unused +TR input should be tied to  $V_{DD}$ . An unused -TR input should be tied to  $V_{SS}$ . A RESET (on low level) is provided for immediate termination of the output pulse or to prevent output pulses when power is turned on. An unused RESET input should be tied to  $V_{DD}$ . However, if an entire section of the CD4098B is not used, its RESET should be tied to  $V_{SS}$ . See Table I.

In normal operation the circuit triggers (extends the output pulse one period) on the application of each new trigger pulse. For operation in the non-retriggerable mode,  $\bar{Q}$  is connected to -TR when leading-edge triggering (+TR) is used or Q is connected to +TR when trailing-edge triggering (-TR) is used.

The time period (T) for this multivibrator can be approximated by:  $T_X = \frac{1}{2} R_X C_X$  for  $C_X \geq 0.01 \mu F$ . Time periods as a function of  $R_X$  for values of  $C_X$  and  $V_{DD}$  are given in Fig. 8. Values of T vary from unit to unit and as a function of voltage, temperature, and  $R_X C_X$ .

The minimum value of external resistance,  $R_X$ , is 5 k $\Omega$ . The maximum value of external capacitance,  $C_X$ , is 100  $\mu F$ . Fig. 9 shows time periods as a function of  $C_X$  for values of  $R_X$  and  $V_{DD}$ .

The output pulse width has variations of  $\pm 2.5\%$  typically, over the temperature range of  $-55^\circ C$  to  $125^\circ C$  for  $C_X=1000$  pF and  $R_X=100$  k $\Omega$ .

For power supply variations of  $\pm 5\%$ , the output pulse width has variations of  $\pm 0.5\%$  typically, for  $V_{DD}=10$  V and 15 V and  $\pm 1\%$  typically, for  $V_{DD}=5$  V at  $C_X=1000$  pF and  $R_X=5$  k $\Omega$ .

These types are supplied in 16-lead hermetic dual-in-line ceramic packages (D and F suffixes), 16-lead dual-in-line plastic package (E suffix), 16-lead ceramic flat packages (K suffix), and in chip form (H suffix).

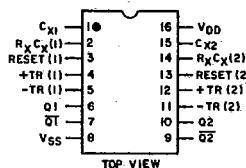
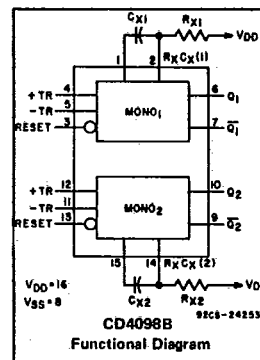
The CD4098B is similar to type MC14528.

#### Features:

- Retriggerable/resettable capability
- Trigger and reset propagation delays independent of  $R_X, C_X$
- Triggering from leading or trailing edge
- Q and  $\bar{Q}$  buffered outputs available
- Separate resets
- Wide range of output-pulse widths
- 100% tested for maximum quiescent current at 20 V
- Maximum input current of 1  $\mu A$  at 18 V over full package-temperature range; 100 nA at 18 V and  $25^\circ C$
- Noise margin (full package-temperature range):
  - 1 V at  $V_{DD}=5$  V
  - 2 V at  $V_{DD}=10$  V
  - 2.5 V at  $V_{DD}=15$  V
- 5-V, 10-V, and 15-V parametric ratings
- Standardized, symmetrical output characteristics
- Meets all requirements of JEDEC Tentative Standard No. 13A, "Standard Specifications for Description of 'B' Series CMOS Devices."

#### Applications:

- Pulse delay and timing
- Pulse shaping
- Astable multivibrator



TERMINALS 1, 6, 15 ARE ELECTRICALLY CONNECTED INTERNALLY  
92CS-24848R1  
**TERMINAL ASSIGNMENT**

#### MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE RANGE, ( $V_{DD}$ ) (Voltages referenced to $V_{SS}$ Terminal)	0.5 to +20 V
INPUT VOLTAGE RANGE, ALL INPUTS (Voltages referenced to $V_{SS}$ Terminal)	-0.5 to $V_{DD} + 0.5$ V
DC INPUT CURRENT, ANY ONE INPUT	$\pm 10$ $\mu A$
POWER DISSIPATION PER PACKAGE ( $P_D$ ):	
For $T_A = -40$ to $+60^\circ C$ (PACKAGE TYPE E)	500 mW
For $T_A = +60$ to $+85^\circ C$ (PACKAGE TYPE E)	Derate Linearly at 12 mW/ $^\circ C$ to 200 mW
For $T_A = -55$ to $+100^\circ C$ (PACKAGE TYPES D, F, K)	500 mW
For $T_A = +100$ to $+125^\circ C$ (PACKAGE TYPES D, F, K)	Derate Linearly at 12 mW/ $^\circ C$ to 200 mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR	
FOR $T_A =$ FULL PACKAGE-TEMPERATURE RANGE (All Package Types)	100 mW
OPERATING-TEMPERATURE RANGE ( $T_A$ ):	
PACKAGE TYPES D, F, K, H	55 to $+125^\circ C$
PACKAGE TYPE E	40 to $+185^\circ C$
LEAD TEMPERATURE RANGE ( $T_{stg}$ )	65 to $+150^\circ C$
LEAD TEMPERATURE (DURING SOLDERING):	
At distance 1/16 $\pm$ 1/32 inch (1.59 $\pm$ 0.79 mm) from case for 10 s max.	$+265^\circ C$

#### RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	$V_{DD}$ V	LIMITS		UNITS
		MIN.	MAX.	
Supply-Voltage Range (For $T_A =$ Full Package-Temperature Range)	-	3	18	V
Trigger Pulse Width $t_W$ (TR)	5	140	-	ns
	10	60	-	
	15	40	-	
Reset Pulse Width $t_W$ (R) (This is a function of $C_X$ )	-	See Dynamic Char. Chart and Fig. 10		-
Trigger Rise or Fall Time $t_r$ (TR), $t_f$ (TR)	5 - 15	-	100	$\mu s$

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TABLE I  
 CD4098B FUNCTIONAL TERMINAL CONNECTIONS

FUNCTION	VDD TO TERM. NO.		VSS TO TERM. NO.		INPUT PULSE TO TERM. NO.		OTHER CONNECTIONS	
	MONO <sub>1</sub>	MONO <sub>2</sub>	MONO <sub>1</sub>	MONO <sub>2</sub>	MONO <sub>1</sub>	MONO <sub>2</sub>	MONO <sub>1</sub>	MONO <sub>2</sub>
Leading-Edge Trigger/Retriggerable	3, 5	11, 13			4	12		
Leading-Edge Trigger/Non-retriggerable	3	13			4	12	5-7	11-9
Trailing-Edge Trigger/Retriggerable	3	13	4	12	5	11		
Trailing-Edge Trigger/Non-retriggerable	3	13			5	11	4-6	12-10
Unused Section	5	11	3, 4	12, 13				

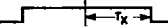
NOTES:

1. A RETRIGGERABLE ONE-SHOT MULTIVIBRATOR HAS AN OUTPUT PULSE WIDTH WHICH IS EXTENDED ONE FULL TIME PERIOD ( $T_X$ ) AFTER APPLICATION OF THE LAST TRIGGER PULSE. The minimum time between retriggering edges (or trigger and retrigger edges) is 40 per cent of ( $T_X$ ).
2. A NON-RETRIGGERABLE ONE-SHOT MULTIVIBRATOR HAS A TIME PERIOD  $T_X$  REFERENCED FROM THE APPLICATION OF THE FIRST TRIGGER PULSE.

INPUT PULSE TRAIN



RETRIGGERABLE MODE PULSE WIDTH (+TR MODE)



NON-RETRIGGERABLE MODE PULSE WIDTH (+TR MODE)

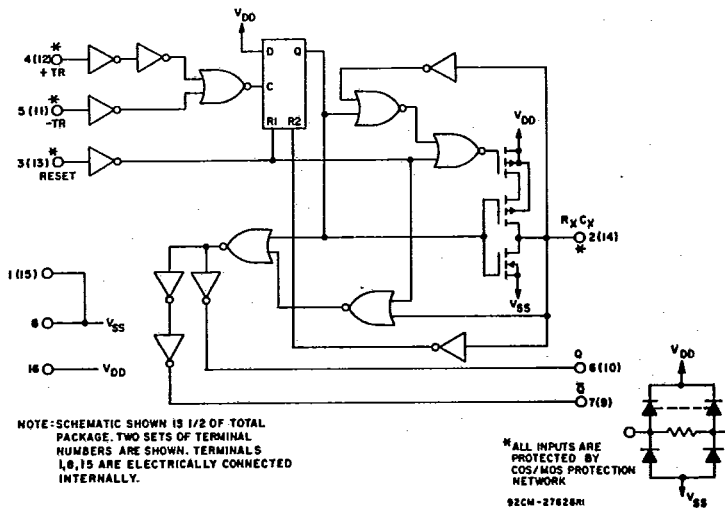
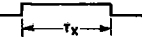


Fig. 4 - CD4098B logic diagram.

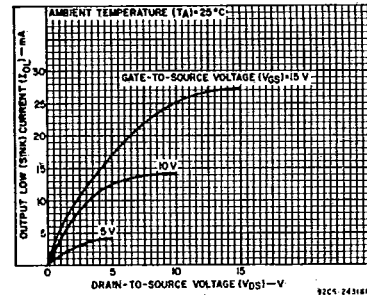


Fig. 1 - Typical output low (sink) current characteristics.

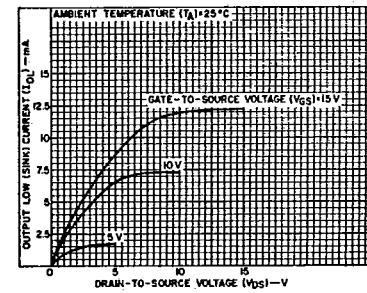


Fig. 2 - Minimum output low (sink) current characteristics.

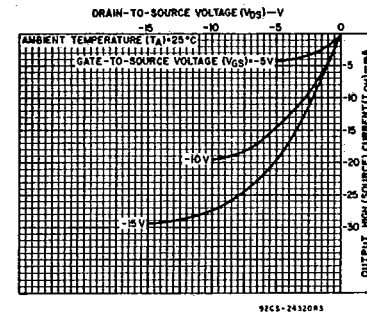


Fig. 3 - Typical output high (source) current characteristics.

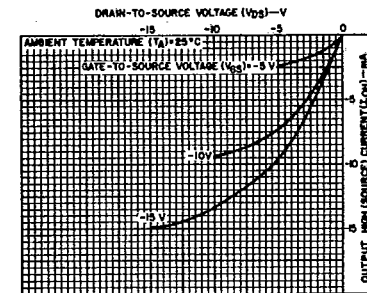


Fig. 5 - Minimum output high (source) current characteristics.

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#### STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V <sub>O</sub> (V)	V <sub>IN</sub> (V)	V <sub>DD</sub> (V)	Values at -55, +25, +125 Apply to D, F, K, H, pkgs.				Values at -40, +25, +85 Apply to E Pkgs.			
				-55	-40	+85	+125	+25			
								Min.	Typ.	Max.	
Quiescent Device Current I <sub>DD</sub> Max.	-	0,5	5	1	1	30	30	-	0.02	1	μA
	-	0,10	10	2	2	60	60	-	0.02	2	
	-	0,15	15	4	4	120	120	-	0.02	4	
	-	0,20	20	20	20	600	600	-	0.04	20	
Output Low (Sink) Current, I <sub>OL</sub> Min.	0.4	0,5	5	0.64	0.61	0.42	0.36	0.51	1	-	mA
	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6	-	
	1.5	0,15	15	4.2	4	2.8	2.4	3.4	6.8	-	
Output High (Source) Current, I <sub>OH</sub> Min.	4.6	0,5	5	-0.64	-0.61	-0.42	-0.36	-0.51	-1	-	
	2.5	0,5	5	-2	-1.8	-1.3	-1.15	-1.6	-3.2	-	
	9.5	0,10	10	-1.6	-1.5	-1.1	-0.9	-1.3	-2.6	-	
	13.5	0,15	15	-4.2	-4	-2.8	-2.4	-3.4	-6.8	-	
Output Voltage: Low-Level, V <sub>OL</sub> Max.	-	0,5	5	0.05				-	0	0.05	V
	-	0,10	10	0.05				-	0	0.05	
	-	0,15	15	0.05				-	0	0.05	
Output Voltage: High-Level, V <sub>OH</sub> Min.	-	0,5	5	4.95				4.95	5	-	
	-	0,10	10	9.95				9.95	10	-	
	-	0,15	15	14.95				14.95	15	-	
Input Low Voltage, V <sub>IL</sub> Max.	0.5, 4.5	-	5	1.5				-	-	1.5	V
	1.9	-	10	3				-	-	3	
	1.5, 13.5	-	15	4				-	-	4	
Input High Voltage, V <sub>IH</sub> Min.	0.5, 4.5	-	5	3.5				3.5	-	-	
	1.9	-	10	7				7	-	-	
	1.5, 13.5	-	15	11				11	-	-	
Input Current, I <sub>IN</sub> Max.	-	0,18	18	±0.1	±0.1	±1	±1	-	±10 <sup>-5</sup>	±0.1	μA
Output Leakage Current, I <sub>OUT</sub> Max.	0,18	0,18	18	±0.4	±0.4	±12	±12	-	±10 <sup>-4</sup>	±0.4	μA

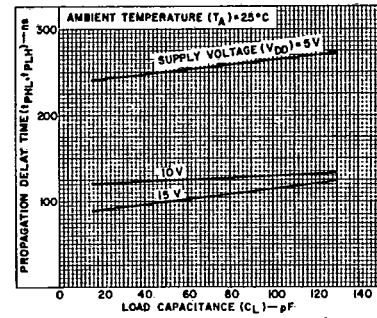


Fig. 6 - Typical propagation delay time vs. load capacitance, trigger into Q out. (All values of C<sub>X</sub> and R<sub>X</sub>.)

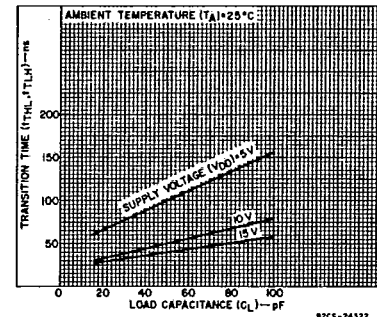


Fig. 7 - Transition time vs. load capacitance for R<sub>X</sub> = 5 kΩ-10000 kΩ and C<sub>X</sub> = 15 pF-10000 pF.

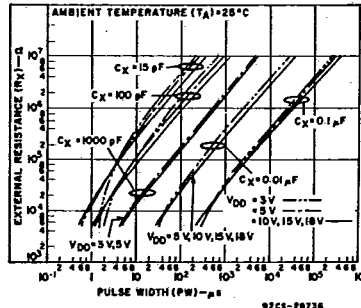


Fig. 8 - Typical external resistance vs. pulse width.

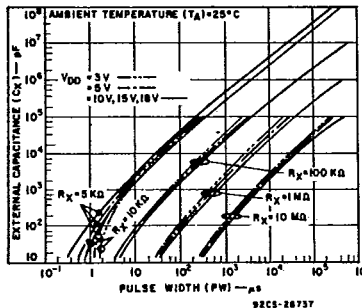


Fig. 9 - Typical external capacitance vs. pulse width.

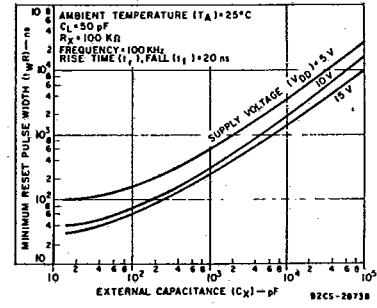


Fig. 10 - Typical minimum reset pulse width vs. external capacitance.

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#### DYNAMIC ELECTRICAL CHARACTERISTICS

At  $T_A = 25^\circ\text{C}$ ; Input  $t_r, t_f = 20\text{ ns}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$

CHARACTERISTIC	TEST CONDITIONS			LIMITS		UNITS
	$R_X$ (k $\Omega$ )	$C_X$ (pF)	$V_{DD}$ (V)	Typ.	Max.	
Trigger Propagation Delay Time +TR, -TR to Q, $\bar{Q}$ $t_{PHL}$ , $t_{PLH}$	5 to 10,000	$\geq 15$	5	250	600	ns
			10	125	250	
			15	100	200	
Minimum Trigger Pulse Width, $t_{WH}$ , $t_{WL}$	5 to 10,000	$\geq 15$	5	70	140	ns
			10	30	60	
			15	20	40	
Transition Time, $t_{TLH}$	5 to 10,000	$\geq 15$	5	100	200	ns
			10	50	100	
			15	40	80	
$t_{THL}$	5 to 10,000	15 to 10,000	5	100	200	ns
			10	50	100	
			15	40	80	
	5 to 10,000	0.01 $\mu\text{F}$ to 0.1 $\mu\text{F}$	5	150	300	
			10	75	150	
			15	65	130	
5 to 10,000	0.1 $\mu\text{F}$ to 1 $\mu\text{F}$	5	250	500		
		10	150	300		
		15	80	160		
Reset Propagation Delay Time, $T_{PHL}$ , $T_{PLH}$	5 to 10,000	$\geq 15$	5	225	450	ns
			10	125	250	
			15	75	150	
Minimum Reset Pulse Width, $t_{WR}$	100	15	5	100	200	ns
			10	40	80	
			15	30	60	
		0.1 $\mu\text{F}$	5	600	1200	
			10	300	600	
			15	250	600	
Trigger Rise or Fall Time $t_r$ (TR), $t_f$ (TR)	-	-	5 to 15	-	100	$\mu\text{s}$
Pulse Width Match Between Circuits in Same Package	10	10,000	5	5	10	%
			10	7.5	15	
			15	7.5	15	
Input Capacitance, $C_{IN}$	Any Input			5	7.5	pF

#### TEST CIRCUITS

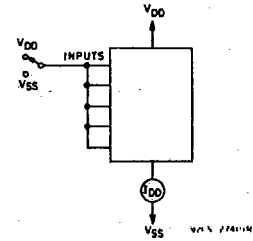


Fig. 12 - Quiescent-device-current test circuits.

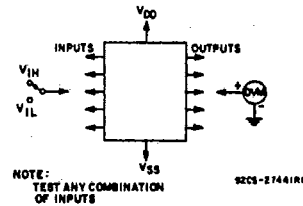


Fig. 13 - Input-voltage test circuit.

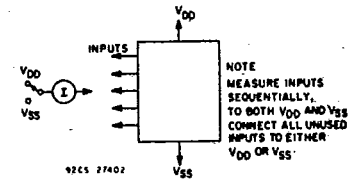


Fig. 14 - Input leakage current test circuit.

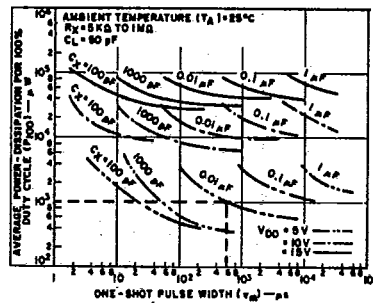
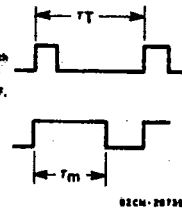


Fig. 11 - Average power dissipation vs. one-shot pulse width.

To calculate average power dissipation (P) for less than 100% duty cycle:  
 $P_{100}$  = average power for 100% duty cycle  
 $P = \left(\frac{t_m}{T_T}\right) P_{100}$  where  $t_m$  = one-shot pulse width  
 $T_T$  = trigger pulse period  
 e.g. For  $t_m = 800\ \mu\text{s}$ ,  $T_T = 1000\ \mu\text{s}$ ,  $C_X = 0.01\ \mu\text{F}$ ,  
 $V_{DD} = 5\text{ V}$ ,  
 $V_{OL} = 0.5\text{ V}$ ,  
 $V_{OH} = 1.5\text{ V}$   
 $P^* = \left(\frac{800}{1000}\right) 10^3\ \mu\text{W} = 800\ \mu\text{W}$  (see dotted line on graph)



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**APPLICATIONS**

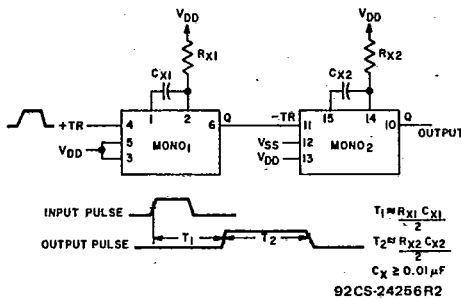


Fig. 15 - Pulse delay.

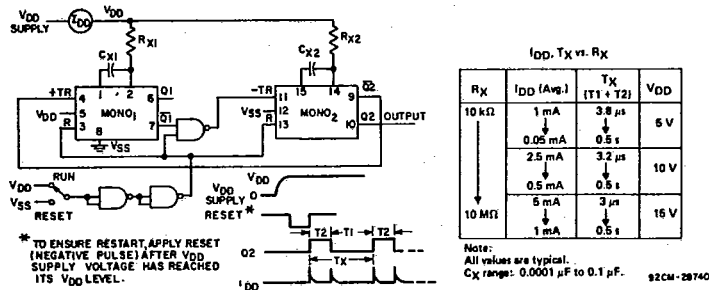
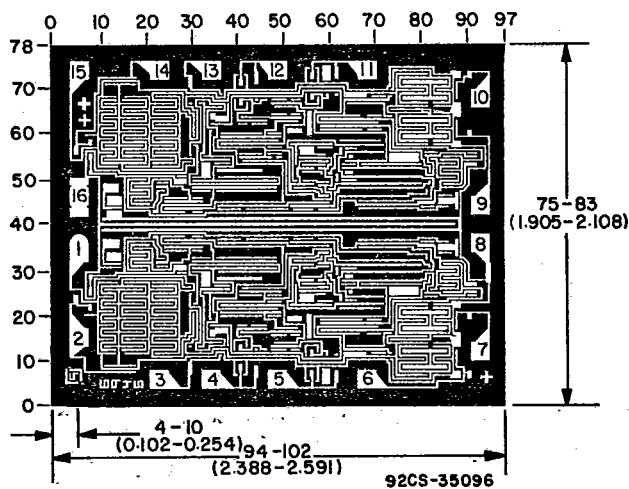


Fig. 16 - Astable multivibrator with restart after reset capability.



**Dimensions and Pad Layout for CD4098BH**

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10<sup>-3</sup> inch).

The photographs and dimensions of each CMOS chip represent a chip when it is part of the wafer. When the wafer is separated into individual chips, the angle of cleavage may vary with respect to the chip face for different chips. The actual dimensions of the isolated chip, therefore, may differ slightly from the nominal dimensions shown. The user should consider a tolerance of -3 mils to +16 mils applicable to the nominal dimensions shown.