

# GD4528B

## DUAL RETRIGGERABLE RESETTABLE MONOSTABLE MULTIVIBRATOR

**DESCRIPTION** — The 4528B is a Dual Retriggerable Resettable Monostable Multivibrator. Each Multivibrator has an active LOW Input ( $\overline{I_0}$ ), an active HIGH Input ( $I_1$ ), an active LOW Clear Direct Input ( $\overline{C_D}$ ), an Output ( $Q$ ), its Complement ( $\overline{Q}$ ) and two pins for connecting the external timing components ( $C_{ext}$ ,  $C_{ext}/R_{ext}$ ). An external timing capacitor must be connected between  $C_{ext}$  and  $C_{ext}/R_{ext}$  and an external resistor must be connected between  $C_{ext}/R_{ext}$  and  $V_{DD}$ .

A HIGH-to-LOW transition on the  $\overline{I_0}$  Input when the  $I_1$  Input is LOW or a LOW-to-HIGH transition on the  $I_1$  Input when the  $\overline{I_0}$  Input is HIGH produces a positive pulse ( $L \rightarrow H \rightarrow L$ ) on the Q Output and a negative pulse ( $H \rightarrow L \rightarrow H$ ) on the  $\overline{Q}$  Output if the Clear Direct Input ( $\overline{C_D}$ ) is HIGH. A LOW on the Clear Direct Input ( $\overline{C_D}$ ) forces the Q Output LOW, the  $\overline{Q}$  Output HIGH and inhibits any further pulses until the Clear Direct Input ( $\overline{C_D}$ ) is HIGH.

- **RECOMMENDED OPERATING VOLTAGE,  $V_{DD} = 4.5$  TO  $15$  V**
- **TYPICAL OUTPUT PULSE WIDTH VARIATION  $\pm 3\%$  AT  $V_{DD} = 15$  V FROM DEVICE TO DEVICE**
- **TYPICAL OUTPUT PULSE WIDTH STABILITY  $\pm 1\%$  OVER  $-40^\circ\text{C}$  TO  $+85^\circ\text{C}$  TEMPERATURE RANGE AT  $V_{DD} = 10$  V**
- **TYPICAL OUTPUT PULSE WIDTH STABILITY  $\pm 1\%$  AT  $V_{DD} = 10$  V  $\pm 0.25$  V RESETTABLE TRIGGER ON EITHER A HIGH-TO-LOW TRANSITION ON  $\overline{I_0}$  OR A LOW-TO-HIGH TRANSITION ON  $I_1$**
- **COMPLEMENTARY OUTPUTS AVAILABLE**
- **BROAD TIMING RESISTOR RANGE,  $5$  k $\Omega$  TO  $2$  M $\Omega$**
- **OUTPUT PULSE WIDTH INDEPENDENT OF DUTY CYCLE WITH A WIDE  $26$  ns TO  $\infty$  RANGE**

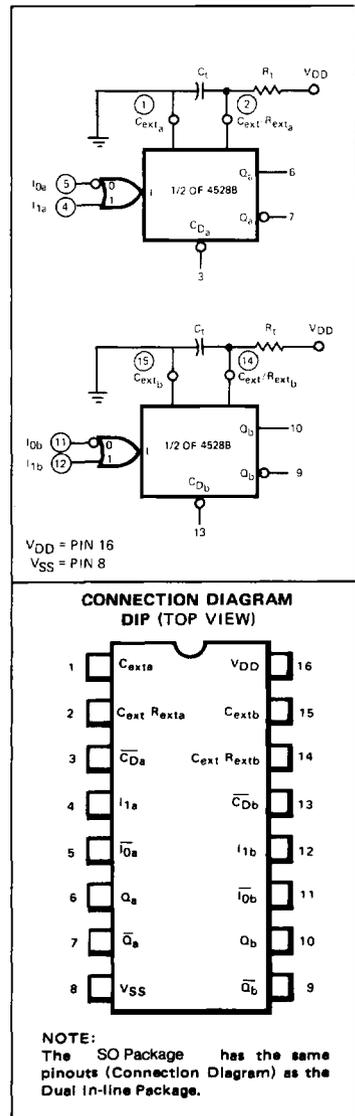
### PIN NAMES

$\overline{I_{0a}}, \overline{I_{0b}}$	Input (H→L Triggered)
$I_{1a}, I_{1b}$	Input (L→H Triggered)
$\overline{C_{Da}}, \overline{C_{Db}}$	Clear Direct (Active LOW) Input
$Q_a, Q_b$	Output
$\overline{Q_a}, \overline{Q_b}$	Complimentary (Active LOW) Output
$C_{exta}, C_{extb}$	External Capacitor Connections
$C_{ext}/R_{exta}, C_{ext}/R_{extb}$	External Capacitor/Resistor Connections

### TRUTH TABLE

$\overline{I_0}$	$I_1$	$\overline{C_D}$	OPERATION
H→L	L	H	Trigger
H	L→H	H	Trigger
X	X	L	Reset

H = HIGH Level  
 L = LOW Level  
 H→L = HIGH-to-LOW Transition  
 L→H = LOW-to-HIGH Transition  
 X = Don't Care



**OPERATING RULES**

**Timing**

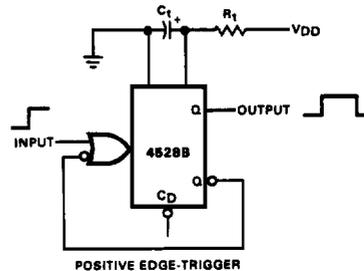
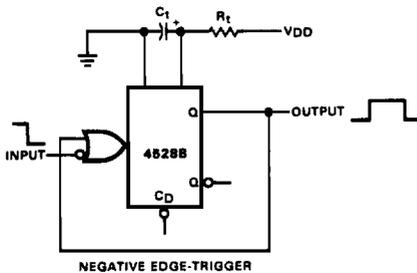
1. An external resistor ( $R_t$ ) and external capacitor ( $C_t$ ) are required as shown in the Logic Diagram. The value of  $R_t$  may vary from 5 k $\Omega$  to 2 M $\Omega$ .
2. The value of  $C_t$  may vary from 0 to any necessary value available. If, however, the capacitor has significant leakage relative to  $V_{DD}/R_t$  the timing diagrams may not represent the pulse width obtained.
3. Polarized capacitors may be used directly. The (+) terminal of a polarized capacitor is connected to pin 2 (14) and the (-) terminal to pin 1 (15). Pin 2 (14) will remain positive with respect to pin 1 (15).
4. The output pulse width can be determined from the pulse width versus  $C_t$  or  $R_t$  graphs (Figures 1 and 2).
5. To obtain variable pulse width by remote trimming, the following circuit is recommended:



6. Under any operating condition,  $C_t$  and  $R_t$  (min) must be kept as close to the circuit as possible to minimize stray capacitance and reduce noise pickup.
7.  $V_{DD}$  and ground wiring should conform to good high frequency standards so that switching transients on  $V_{DD}$  and ground pins do not cause interaction between one shots. Use of a 0.01 to 0.1  $\mu$ F bypass capacitor between  $V_{DD}$  and ground located near the 4528B is recommended.
8. To minimize noise problems, it is recommended that pin 1 and pin 15 be tied externally to  $V_{SS}$ .

**Triggering**

1. The minimum negative pulse width into  $\overline{I_0}$  is 32 ns at  $V_{DD} = 10$  V and the minimum positive pulse width into  $I_1$  is 32 ns at  $V_{DD} = 10$  V.
2. When non-retriggerable operation is required, i.e., when input triggers are to be ignored during a quasi-stable state, input latching is used to inhibit retriggering. The device does not retrigger if an additional trigger input occurs while the capacitor is discharging in response to the initial trigger input.



3. An overriding active LOW level Clear Direct ( $\overline{C_D}$ ) is provided on each multivibrator. By applying a LOW to the  $\overline{C_D}$ , any timing cycle can be terminated or any new cycle inhibited until the LOW Clear Input is removed. Trigger inputs will not produce spikes in the output when the Clear Direct Input is held LOW. A new cycle initiated less than 200 ns after removal of a Clear Direct Input ( $\overline{C_D}$ ) will not have a standard output pulse width.

**DC CHARACTERISTICS:**  $V_{DD}$  as shown,  $V_{SS} = 0$  V (see Note 4)

SYMBOL	PARAMETER		LIMITS									UNITS	TEMP	TEST CONDITIONS
			$V_{DD} = 5$ V			$V_{DD} = 10$ V			$V_{DD} = 15$ V					
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX			
$I_{DD}$	Quiescent Power	XC			20			40			80	$\mu$ A	MIN. 25°C	Cext/Rext = $V_{DD}$ All other inputs at 0 V or $V_{DD}$
					150			300			600		MAX	
	Supply Current	XM			5			10			20	$\mu$ A	MIN. 25°C	
					150			300			600		MAX	

**AC CHARACTERISTICS AND SET-UP REQUIREMENTS:**  $V_{DD}$  as shown,  $V_{SS} = 0$  V,  $T_A = 25^\circ$  C (See Note 3)

SYMBOL	PARAMETER		LIMITS									UNITS	TEST CONDITIONS
			$V_{DD} = 5$ V			$V_{DD} = 10$ V			$V_{DD} = 15$ V				
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX		
$t_{PLH}$	Propagation Delay, $\bar{I}_0$ to Q		205	335		90	130		60	104	ns	$C_L = 50$ pF, $R_L = 200$ k $\Omega$ , Input Transition Times < 20 ns  $R_t = 5$ k $\Omega$ to 2 M $\Omega$ Any $C_t$	
$t_{PHL}$			205	335		90	130		60	104			
$t_{PLH}$	Propagation Delay, $I_1$ to Q		205	335		90	130		60	104	ns		
$t_{PHL}$			205	335		90	130		60	104			
$t_{PLH}$	Propagation Delay, $\bar{C}_D$ to Q		145	230		60	85		40	68	ns		
$t_{PHL}$			145	230		60	85		40	68			
$t_{TLH}$	Output Transition Time		70	135		32	70		22	45	ns		
$t_{THL}$			70	135		32	70		22	45			
$t_{rec}$	$\bar{C}_D$ Recovery Time (Note 1)	-50	-90		-20	-37		0	-25		ns		
$t_{WQ}$	$\bar{I}_0$ Minimum Pulse Width (LOW)	70	45		32	24		26	20		ns		
$t_{W1}$	$I_1$ Minimum Pulse Width (HIGH)	70	45		32	24		26	20		ns		
$t_{WC_D}$	$\bar{C}_D$ Minimum Pulse Width	65	45		32	26		26	21		ns		
$t_{WQ}$	Q Minimum Output Pulse Width		300	500		200	400		150	300	ns		
$t_{WQ}$	Q Output Pulse Width	$R_t = 5$ k $\Omega$ , $C_t = 15$ pF									$\mu$ s		
		4.35	6.25	8	4	5.3	6.6	4	5	6			
		$R_t = 10$ k $\Omega$ , $C_t = 1000$ pF											
$\Delta t$	Change in Q Output Pulse Width over Temperature		$\pm 2$	$\pm 10$		$\pm 1$	$\pm 7$		$\pm 1$	$\pm 5$	%		
$\Delta t$	Change in Q Output Pulse Width over $V_{DD}$	$T_A = -40^\circ$ C to $+85^\circ$ C									%		
			$\pm 2$	$\pm 4$		$\pm 1$	$\pm 2$		$\pm 1$	$\pm 2$			
$t_s$	Set-Up Time, $\bar{C}_D$ to $\bar{I}_0$ or $I_1$ (To prevent change in output)	20	5		-25	-45		-25	-35		ns		
$R_t$	External Timing Resistor Any $V_{DD}$				5		2000				k $\Omega$		
$C_t$	External Timing Capacitor	No Limits									$\mu$ F		

**Notes:**

- The 4528B device does not retrigger if an additional trigger input occurs while the capacitor is discharging in response to the initial trigger input.
- A new cycle initiated less than 200 ns after removal of a Clear Direct Input ( $\bar{C}_D$ ) will not have a standard output pulse width.
- Propagation Delays and Output Transition Times are graphically described in this section under 4000B Series CMOS Family Characteristics.
- Additional D. C. Characteristics are listed in this section under Goldstar 4000B Series CMOS Family Characteristics.
- To minimize power dissipation unused multivibrators should have the Cext/Rext Connection tied to  $V_{DD}$ , the Cext Connection tied to  $V_{SS}$  and all other inputs tied to either  $V_{DD}$  or  $V_{SS}$ .
- It is recommended that Input Rise and Fall Times to Inputs  $\bar{I}_0$  and  $I_1$  be less than 15  $\mu$ s at  $V_{DD} = 5$  V, 4  $\mu$ s at  $V_{DD} = 10$  V and 3  $\mu$ s at  $V_{DD} = 15$  V.

TYPICAL ELECTRICAL CHARACTERISTICS

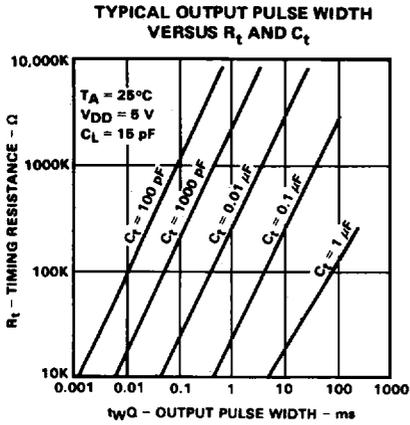


FIGURE 1.

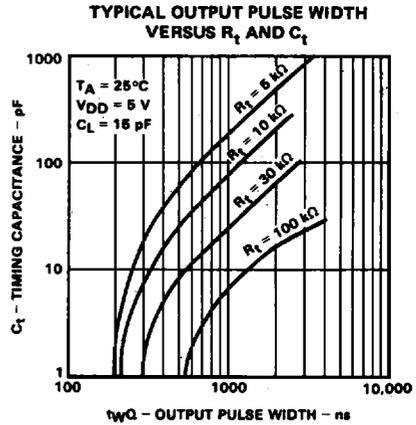
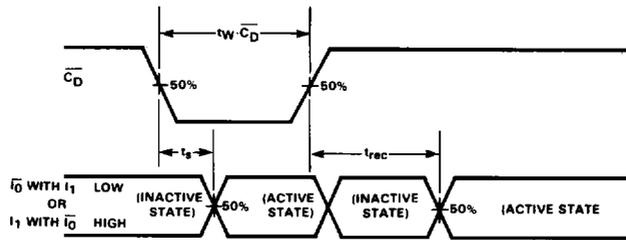
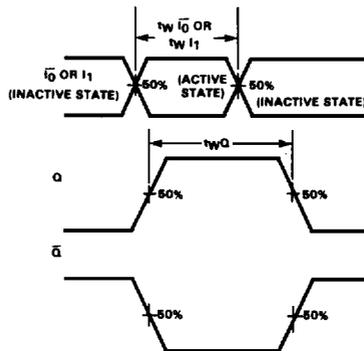


FIGURE 2.

AC WAVEFORMS



Set-up Time,  $\bar{C}_D$  to  $\bar{I}_0$  or  $I_1$ , Recovery Time for  $\bar{C}_D$  and Minimum  $\bar{C}_D$  Pulse Width.



Minimum  $\bar{I}_0$  or  $I_1$  Pulse Width and Minimum Output Pulse Width.

NOTE: Set-up Time and Recovery Time are shown as Positive values, but may specified as Negative values.

APPLICATIONS

The 4528B Monostable Multivibrator has its pulse width determined by an externally supplied Resistor-Capacitor network. A two step procedure is suggested for determining the proper  $R_t C_t$  combination (Equation 1) for a specific pulse width.

The first step is to choose a capacitor. Figure 1 shows pulse width versus resistor value with the capacitor value as the running parameter. A capacitor value is chosen so that the approximate resistor value is between  $20\text{ k}\Omega$  and  $2\text{ M}\Omega$ . Once the capacitor is determined, the timing constant (K) is found from Figure 3 for a specific  $V_{DD}$ . The resistor value is then determined from Equation 2. If the resistor value is less than  $20\text{ k}\Omega$  the timing constant should be increased by 20% and the resistor value re-calculated. The resistor must be larger than  $5\text{ k}\Omega$ .

No upper limit on the capacitor is required. If a large value of  $R_t$  and  $C_t$  are to be used the timing between pulses or duty cycle, must be sufficiently low that the capacitor fully charges to  $V_{DD}$ . Large capacitor values must be sufficiently low in leakage that the resistor value can supply the leakage of the capacitor and still charge the capacitor close to  $V_{DD}$ .

EXAMPLE:

Three pulse widths of 0.1, 1, and 10 ms are to be generated with the 4528B using a single capacitor.

From Figure 1 a capacitor value between 0.01 and .1  $\mu\text{F}$  would be reasonable. A  $0.022\ \mu\text{F}$  capacitor is the only capacitor that is available.

The timing constant for a  $0.022\ \mu\text{F}$  at  $10\text{ V } V_{DD}$  is found from Figure 3 to be approximately 0.3.

The resistor values are then calculated:

Pulse Width	$R_t$
0.1 ms	15.1 $\text{k}\Omega$
1 ms	151.1 $\text{k}\Omega$
10 ms	1.51 $\text{M}\Omega$

The  $15.1\text{ k}\Omega$  is less than  $20\text{ k}\Omega$  so add 20% to the K value and recalculate

Pulse Width	$R_t$	K =
0.1 ms	12.5 $\text{k}\Omega$	.36

Equation 1:  $P.W. = KR_t C_t$

Equation 2:  $P.W. = \frac{R_t}{K C_t}$

- P.W. = Pulse Width (seconds)
- K = Timing Constant
- $C_t$  = Capacitance (Farads)
- $R_t$  = Resistance (ohms)

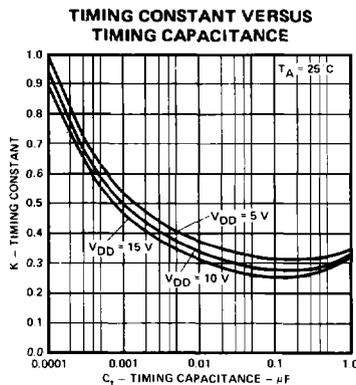


Fig. 3.