

T-51-19

CD4538B Types

CMOS Dual Precision
Monostable Multivibrator

High-Voltage Types (20-Volt Rating)

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
- Schmitt trigger input allows unlimited rise and fall times on +TR and -TR inputs

The RCA-CD4538B dual precision 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 and 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. 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 . Precision control of output pulse widths is achieved through linear CMOS techniques.

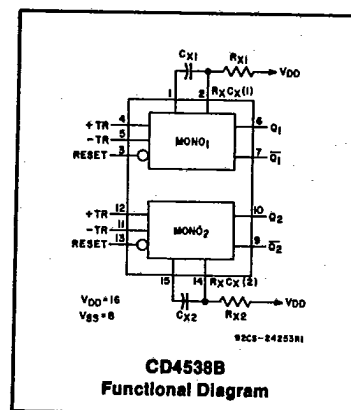
Leading-edge-triggering (+TR) and trailing-edge-triggering (-TR) inputs are provided for triggering from either edge of an input pulse. An unused +TR input should be tied to V_{SS} . An unused -TR input should be tied to V_{DD} . A RESET (on low level) is provided for immediate termination of the output 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 CD4538B is not used, its inputs must be tied to either V_{DD} or V_{SS} . See Table I.

In normal operation the circuit retriggers (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 calculated by: $T = R_x C_x$.

The minimum value of external resistance, R_x , is 4 K Ω . The maximum and minimum values of external capacitance, C_x , are 100 μ F and 5000 pF, respectively.

The CD4538B types are supplied in 16-lead hermetic dual-in-line ceramic packages (D and F suffixes), 16-lead dual-in-line plastic packages (E suffix), 16-lead ceramic flat packages (K suffix), and in chip form (H suffix).

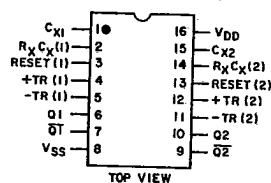
The CD4538B is similar to type MC14538 and is pin-for-pin compatible with the CD4098B.



- 100% tested for maximum quiescent current at 20 V
- Maximum input current of 1 μ A at 18 V over full package-temperature range; 100 nA at 18 V and 25°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. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices."

Applications:

- Pulse delay and timing
- Pulse shaping



TERMINALS 1, 8, 15 ARE
ELECTRICALLY CONNECTED
INTERNALLY
92CS-24 848R1

Terminal Assignment

CD4538B Types

MAXIMUM RATINGS, Absolute-Maximum Values:

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

RECOMMENDED OPERATING CONDITIONS

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

CHARACTERISTIC	V_{DD} (V)	LIMITS		UNITS
		Min.	Max.	
Supply-Voltage Range (For $T_A = \text{Full Package-Temperature Range}$)	—	3	18	V
Input Pulse Width +TR, -TR, or RESET	5	140	—	ns
	10	80	—	
	15	60	—	

TABLE I
CD4538B FUNCTIONAL TERMINAL CONNECTIONS

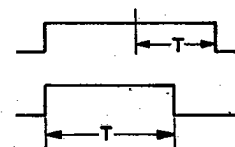
FUNCTION	V_{DD} TO TERM. NO.		V_{SS} TO TERM. NO.		INPUT PULSE TO TERM. NO.		OTHER CONNECTIONS	
	MONO ₁	MONO ₂	MONO ₁	MONO ₂	MONO ₁	MONO ₂	MONO ₁	MONO ₂
Leading-Edge Trigger/ Retriggerable	3, 5	11, 13			4	12		
Leading-Edge Trigger/ Non-Retriggerable	3	13			4	12	5-7	11-9
Trailing-Edge Trigger/ Retriggerable	3	13	4	12	5	11		
Trailing-Edge Trigger/ Non-Retriggerable	3	13			5	11	4-6	12-10

NOTES:

1. A RETRIGGERABLE ONE-SHOT MULTIVIBRATOR HAS AN OUTPUT PULSE WIDTH WHICH IS EXTENDED ONE FULL TIME PERIOD (T) AFTER APPLICATION OF THE LAST TRIGGER PULSE.
2. A NON-RETRIGGERABLE ONE-SHOT MULTIVIBRATOR HAS A TIME PERIOD (T) 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)



92CS-32816

CD4538B Types

STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
				Values at -55, +25, +125 Apply to D, F, K, H. Pkgs. Values at -40, +25, +85 Apply to E Pkgs.							
	V _O (V)	V _{IN} (V)	V _{DD} (V)	-55	-40	+85	+125	Min.	+25 Typ.	Max.	
Quiescent Device Current, I _{DD} Max.	—	0,5	5	5	5	150	150	—	0.04	5	μA
	—	0,10	10	10	10	300	300	—	0.04	10	
	—	0,15	15	20	20	600	600	—	0.04	20	
	—	0,20	20	100	100	3000	3000	—	0.08	100	
Output Low (Sink) Current, I _{OL} 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 _{OH} Min.	4.6	0,5	5	-0.64	-0.61	-0.42	-0.36	-0.51	-1	—	mA
	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 _{OL} 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 _{OH} Min.	—	0,5	5	4.95				4.95	5	—	V
	—	0,10	10	9.95				9.95	10	—	
	—	0,15	15	14.95				14.95	15	—	
Input Low Voltage, V _{IL} 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 _{IH} Min.	0.5,4.5	—	5	3.5				3.5	—	—	V
	1,9	—	10	7				7	—	—	
	1.5,13.5	—	15	11				11	—	—	
Input Current, I _{IN} Max.	—	0,18	18	±0.1	±0.1	±1	±1	—	±10 ⁻⁸	±0.1	μA

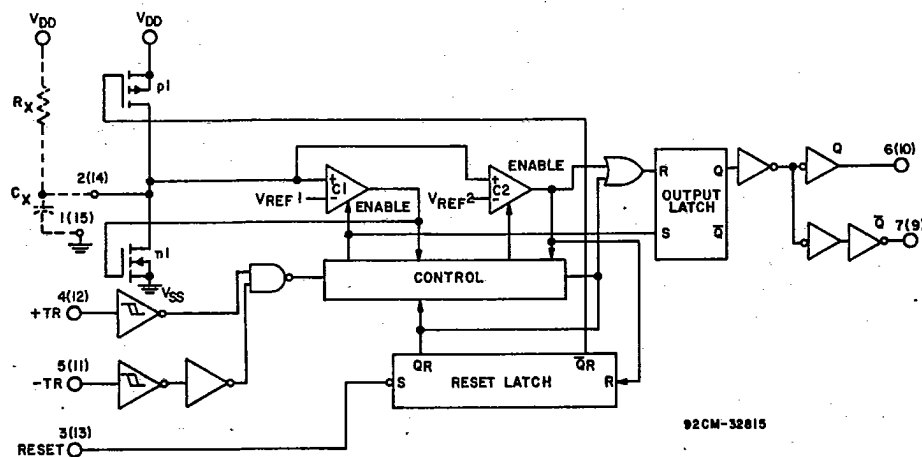


Fig. 1 - Logic diagram (1/2 of device shown).

CD4538B Types

DYNAMIC ELECTRICAL CHARACTERISTICS, At $T_A=25^\circ\text{C}$; Input $t_i, t_r=20\text{ ns}$, $C_L=50\text{ pF}$

CHARACTERISTIC	TEST CONDITIONS V_{DD} (V)	LIMITS			UNITS
		Min.	Typ.	Max.	
Transition Time t_{TLH}, t_{THL}	5	—	100	200	ns
	10	—	50	100	
	15	—	40	80	
Propagation Delay Time: +TR or -TR to Q or $\bar{Q}$	5	—	300	600	
	10	—	150	300	
	15	—	100	220	
Reset to Q or $\bar{Q}$	5	—	250	500	
	10	—	125	250	
	15	—	95	190	
Minimum Input Pulse Width: +TR, -TR or Reset	5	—	80	140	μs
	10	—	40	80	
	15	—	30	60	
Output Pulse Width - Q or $\bar{Q}$: $C_X=0.005\text{ }\mu\text{F}$, $R_X=10\text{ K}\Omega$ *	5	57	60.6	64.5	
	10	55	58.9	63.0	
	15	55	59.1	63.5	
$C_X=0.1\text{ }\mu\text{F}$, $R_X=100\text{ K}\Omega$	5	9.4	9.97	10.5	ms
	10	9.4	9.95	10.6	
	15	9.5	10.00	10.6	
$C_X=10\text{ }\mu\text{F}$, $R_X=100\text{ K}\Omega$	5	0.95	1.00	1.06	s
	10	0.95	1.00	1.06	
	15	0.96	1.01	1.07	
Pulse Width Match between circuits in same package: $C_X=0.1\text{ }\mu\text{F}$, $R_X=100\text{ K}\Omega$	5	—	± 1	—	%
	10	—	± 1	—	
	15	—	± 1	—	
Minimum Retrigger Time t_{rr}	5	0	—	—	ns
	10	0	—	—	
	15	0	—	—	
Input Capacitance C_{IN}	Any Input	—	5.0	7.5	pF

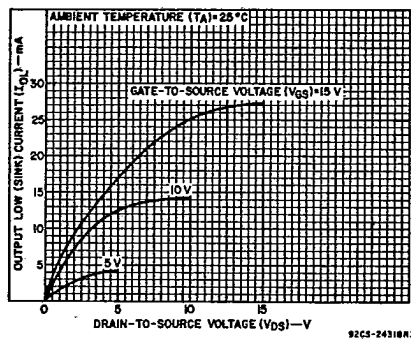
*Note: Minimum R_X value=4 K Ω , minimum C_X value=5000 pF.

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

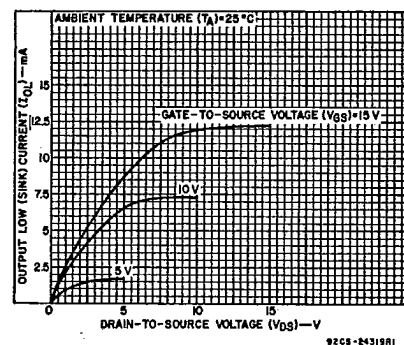
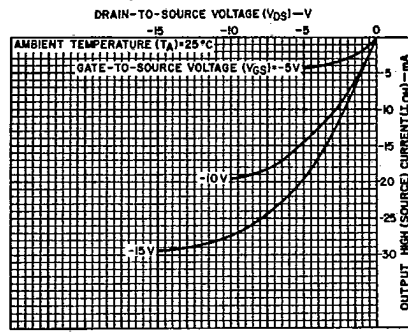


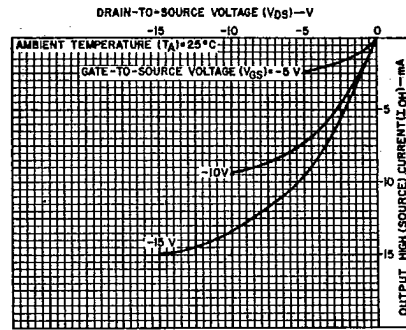
Fig. 3 - Minimum output low (sink) current characteristics.

CD4538B Types



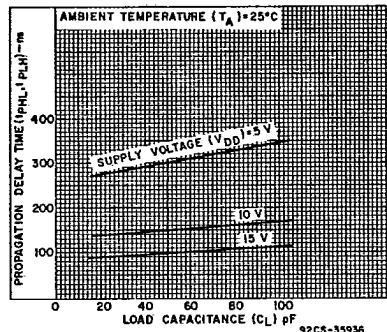
92CS-24320A3

Fig. 4 - Typical output high (source) current characteristics.



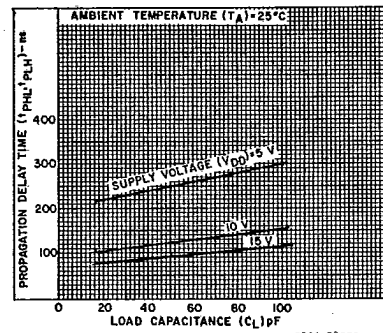
92CS-24321R2

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



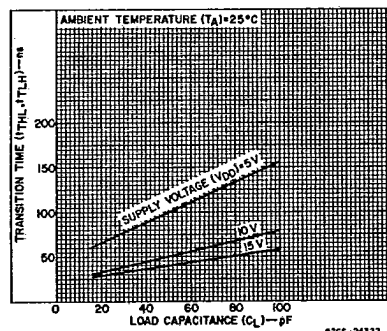
92CS-35936

Fig. 6 - Typical propagation delay time as a function of load capacitance (+TR or -TR to Q or Q̄).



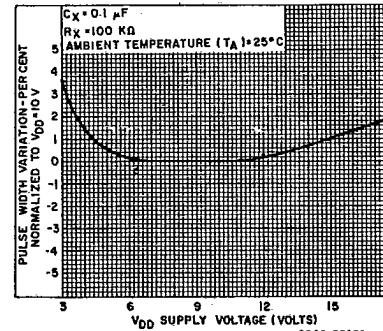
92CS-35938

Fig. 7 - Typical propagation delay time as a function of load capacitance (RESET to Q or Q̄).



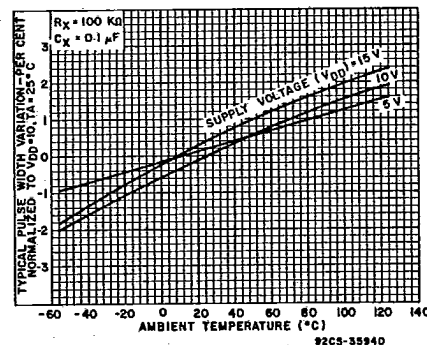
92CS-24322

Fig. 8 - Typical transition time as a function of load capacitance.

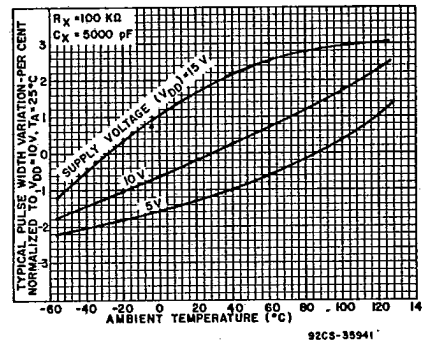


92CS-35939

Fig. 9 - Typical pulse-width variation as a function of supply voltage.



92CS-35940

Fig. 10 - Typical pulse-width variation as a function of temperature ($R_X=100\text{ K}\Omega$, $C_X=0.1\text{ }\mu\text{F}$).

92CS-35941

Fig. 11 - Typical pulse-width variation as a function of temperature ($R_X=100\text{ K}\Omega$, $C_X=5000\text{ pF}$).

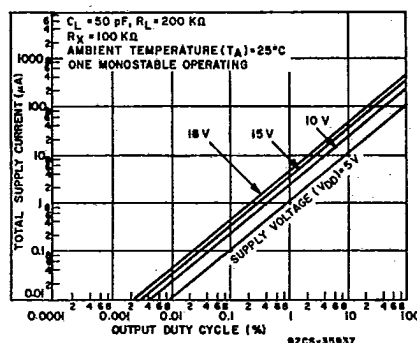
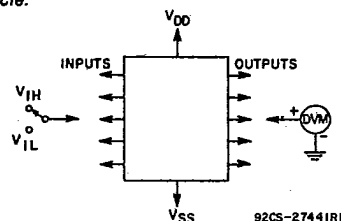


Fig. 12 - Typical total supply current as a function of output duty cycle.



Test any combination of inputs.

Fig. 14 - Input-voltage test circuit.

Power-Down Mode

During a rapid power-down condition, as would occur with a power-supply short circuit or with a poorly filtered power supply, the energy stored in C_X could discharge into Pin 2 or 14. To avoid possible device damage in this mode, when C_X is ≥ 0.5 microfarad, a protection diode with a 1-ampere or higher rating (1N5395 or equivalent) and a separate ground return for C_X should be provided as shown in Fig. 16.

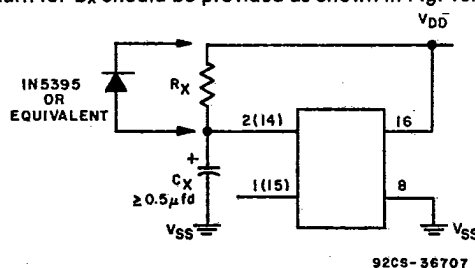


Fig. 16 - Rapid power-down protection circuit.

An alternate protection method is shown in Fig. 17, where a 51-ohm current-limiting resistor is inserted in series with C_X . Note that a small pulse width decrease will occur however, and R_X must be appropriately increased to obtain the originally desired pulse width.

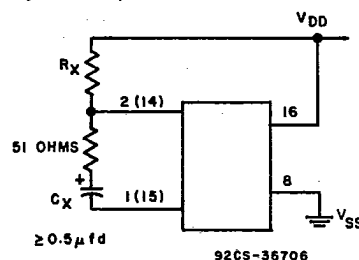


Fig. 17 - Alternate rapid power-down protection circuit.

CD4538B Types

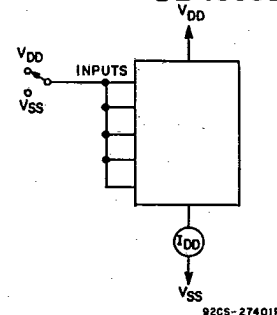


Fig. 13 - Quiescent device current test circuit.

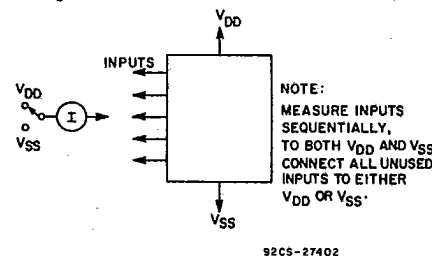
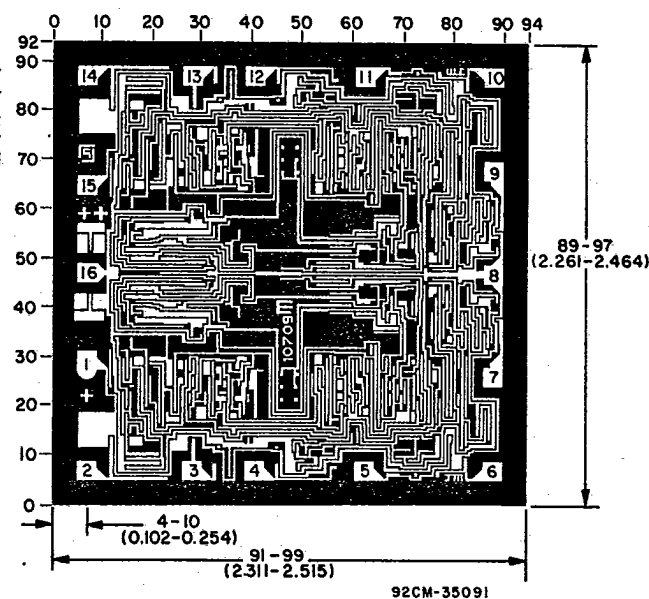


Fig. 15 - Input-leakage-current test circuit.



Dimensions and pad layout for CD4538BH.

Dimensions in parentheses are in millimeters and are derived from the basic inch dimension as indicated. Grid graduations are in mils (10^{-3} 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.