TEXAS INSTRUMENTS
Data sheet acquired from Harris Semiconductor
SCHS093

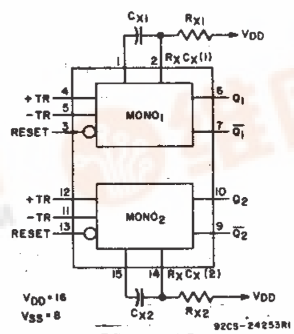
CD14538B Types

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 $\overline{Q}$ buffered outputs available*
- *Separate resets*
- *Replaces CD4538B Type*



CD14538B FUNCTIONAL DIAGRAM

■ CD14538B 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 $\overline{Q}$ 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 CD14538B 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, $\overline{Q}$ 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 KΩ. The minimum and maximum values of external capacitance, C_X, are 0 pF and 100 µF, respectively.

The CD14538B 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), and in chip form (H suffix).

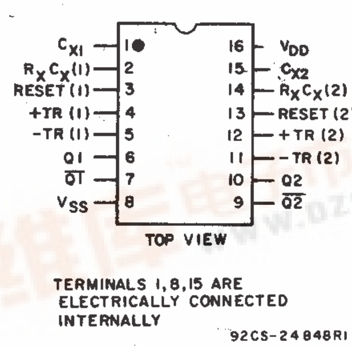
The CD14538B is interchangeable with type MC14538 and is similar to and pin-compatible with the CD4098B* and CD4538B. It can replace the CD4538B which type is not recommended for new designs.

*T = 0.5 $R_X C_X$ for $C_X \geq$ 1000 pF   #T = $R_X C_X$; $C_X$min = 5000 pF

- *Wide range of output-pulse widths*
- *Schmitt-trigger input allows unlimited rise and fall times on +TR and −TR inputs*
- *100% tested for maximum quiescent current at 20 V*
- *Maximum input current of 1 µA 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*



Terminal Assignment

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DC SUPPLY-VOLTAGE RANGE, (V_{DD})
Voltages referenced to V_{SS} Terminal) .... -0.5V to +20V
INPUT VOLTAGE RANGE, ALL INPUTS .... -0.5V to V_{DD} +0.5V
DC INPUT CURRENT, ANY ONE INPUT .... ±10mA
POWER DISSIPATION PER PACKAGE (P_D):
For T_A = -55°C to +100°C 500mW
For T_A = +100°C to +125°C .... Derate Linearity at 12mW/°C to 200mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR
FOR T_A = FULL PACKAGE-TEMPERATURE RANGE (All Package Types).......... 100mW
OPERATING-TEMPERATURE RANGE (T_A) .... -55°C to +125°C
STORAGE TEMPERATURE RANGE (T_{stg}) .... -65°C to +150°C
LEAD TEMPERATURE (DURING SOLDERING):
At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10s max .... +265°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=Full Package-Temperature Range)		—	3	18	V
Input Pulse Width +TR, -TR, or RESET	t_{WH}, t_{WL}	5	140	—	ns
		10	80	—	
		15	60	—	

TABLE I
CD4538B FUNCTIONAL TERMINAL CONNECTIONS

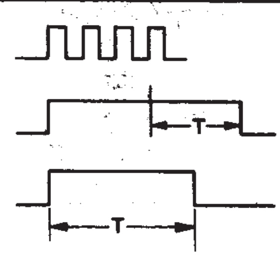
FUNCTIION	V_{DD} TO TERM. NO.		V_{SS} TO TERM. NO.		INPUT PULSE TO TERM. NO.		OTHER CONNECTIONS	
	$MONO_1$	$MONO_2$	$MONO_1$	$MONO_2$	$MONO_1$	$MONO_2$	$MONO_1$	$MONO_2$
Leading-Edge Trigger/ Retriggerable	3, 5	11, 13			4	12		
Leading-Edge Trigger/ Non-Retriggerable	3	13			4	12	5-7	11-9
Trailing-Edge 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)



STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V_O (V)	V_{IN} (V)	V_{DD} (V)	-55	-40	+85	+125	+25 Min.	+25 Typ.	+25 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	—	
	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	—	
	—	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	—	—	
	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	—	$\pm10^{-5}$	±0.1	μA

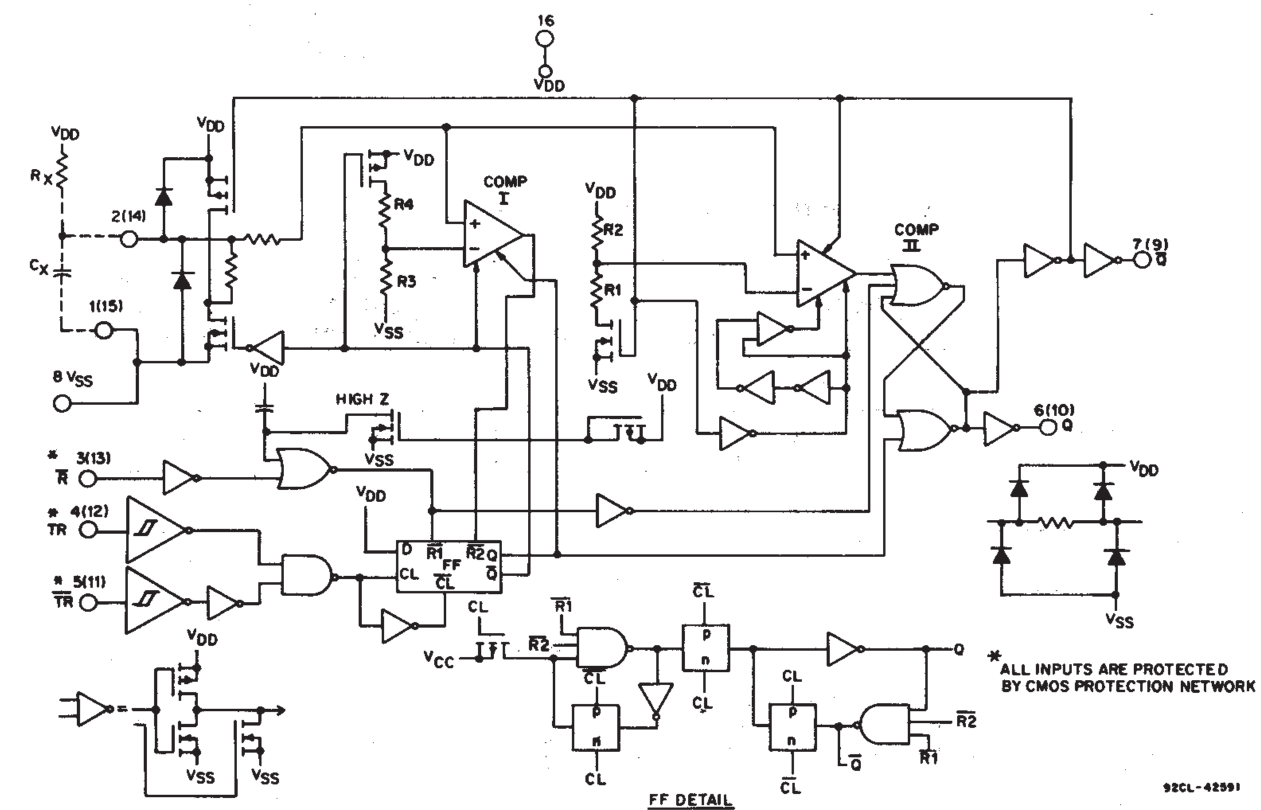


Fig. 1 - Logic diagram (½ of device shown).

DYNAMIC ELECTRICAL CHARACTERISTICS, At T_A=25° C; Input t_r,t_f=20 ns, C_L=50 pF

CHARACTERISTIC		TEST CONDITIONS V_{DD} (V)	LIMITS Min.	Typ.	Max.	UNITS
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 $\overline{Q}$	t_{PLH}, t_{PHL}	5	—	300	600	
		10	—	150	300	
		15	—	100	220	
Reset to Q or $\overline{Q}$		5	—	250	500	
		10	—	125	250	
		15	—	95	190	
Minimum Input Pulse Width: +TR, -TR or Reset	t_{WH}, t_{WL}	5	—	80	140	
		10	—	40	80	
		15	—	30	60	
Output Pulse Width - Q or $\overline{Q}$: C_X = 0.002 μF, R_X = 100 KΩ	T	5	198	210	230	μs
		10	200	212	232	
		15	202	214	234	
C_X=0.1 μF, R_X=100 KΩ		5	9.4	9.97	10.5	ms
		10	9.4	9.95	10.6	
		15	9.5	10	10.6	
C_X=10 μF, R_X=100 KΩ		5	0.95	1	1.06	s
		10	0.95	1	1.06	
		15	0.96	1.01	1.07	
Pulse Width Match between circuits in same package: C_X=0.1 μF, R_X=100 KΩ	$\frac{100 (T_1-T_2)}{T_1}$	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	7.5	pF

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

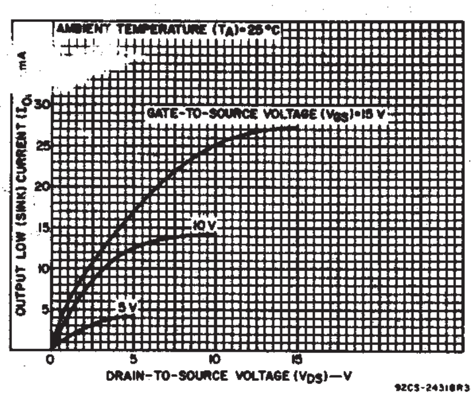


Fig. 2 - Typical output low (sink) current characteristics.

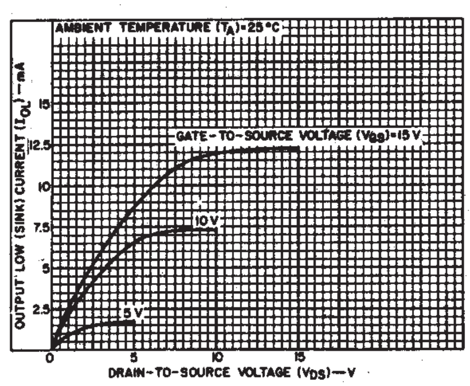


Fig. 3 - Minimum output low (sink) current characteristics.

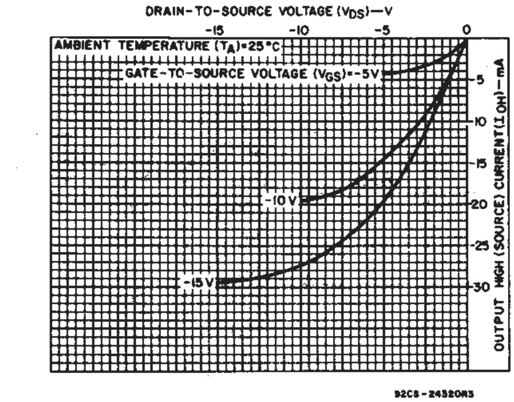


Fig. 4 - Typical output high (source) current characteristics.

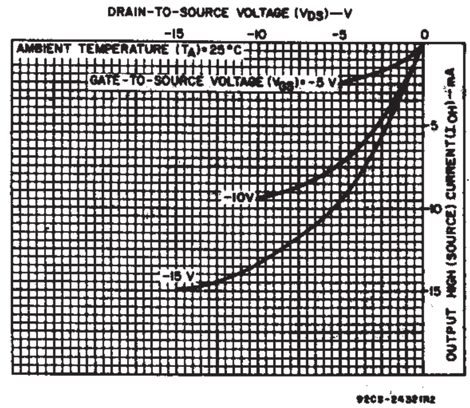


Fig. 5 - Minimum output high (source) current characteristics.

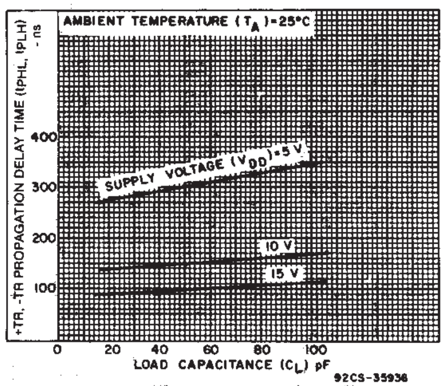


Fig. 6 - Typical propagation delay time as a function of load capacitance (+TR or −TR to Q or $\overline{Q}$).

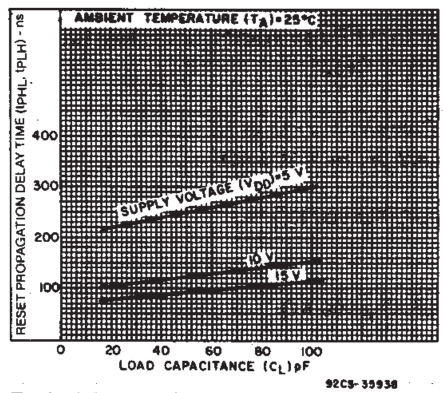


Fig. 7 - Typical propagation delay time as a function of load capacitance (RESET to Q or $\overline{Q}$).

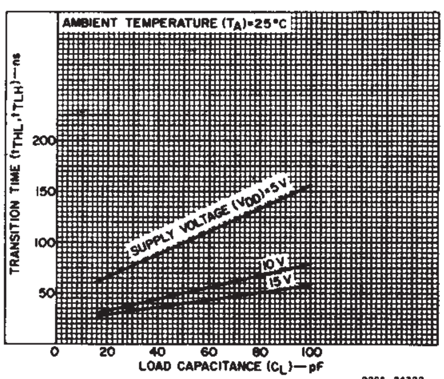


Fig. 8 - Typical transition time as a function of load capacitance.

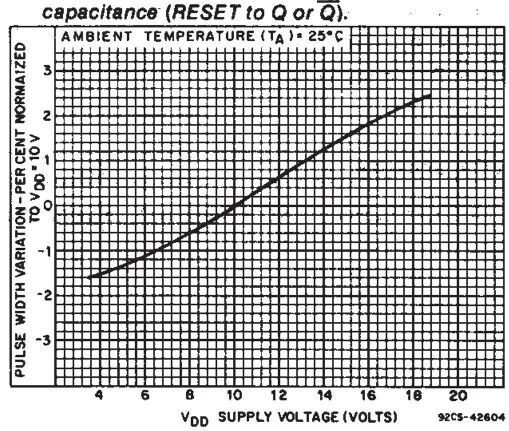


Fig. 9 - Typical pulse-width variation as a function of supply voltage.

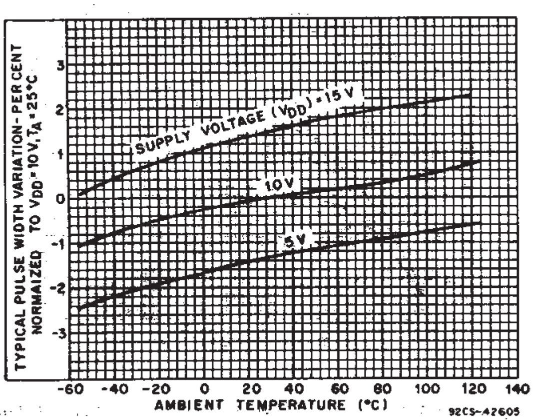


Fig. 10 - Typical pulse-width variation as a function of temperature (R_X=100 KΩ, C_X=0.1 μF).

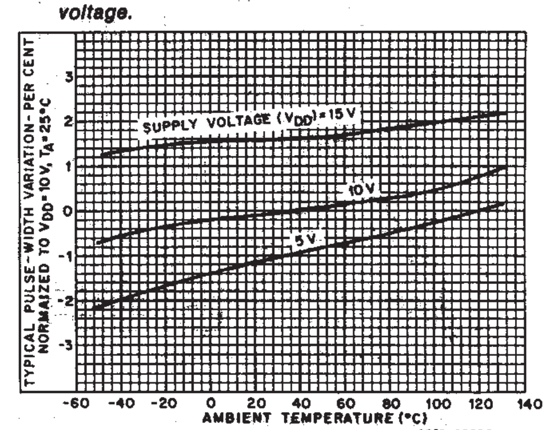


Fig. 11 - Typical pulse-width variation as a function of temperature (R_X=100 KΩ, C_X=2000 pF).

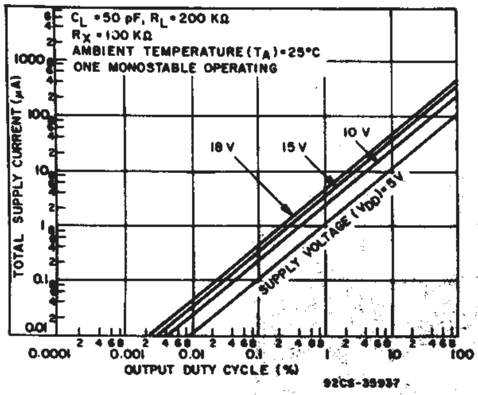


Fig. 12 - Typical total supply current as a function of output duty cycle.

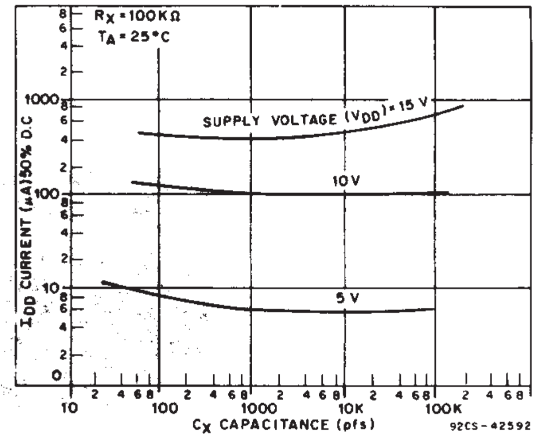
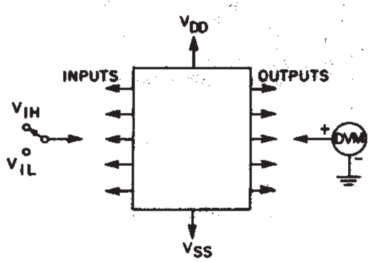
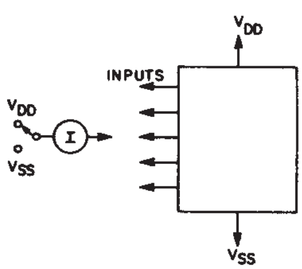


Fig. 13 - Typical total supply current as a function of load capacitance.



NOTE:
1. Test any combination of inputs.
2. When measuring V_{IH} or V_{IL} for Schmitt trigger inputs (+TR, -TR), the input must first be brought to V_{DD} or V_{SS}, respectively, then reduced to the specified limit.

Fig. 14 - Input voltage test circuit.



NOTE:
MEASURE INPUTS SEQUENTIALLY, TO BOTH V_{DD} AND V_{SS}. CONNECT ALL UNUSED INPUTS TO EITHER V_{DD} OR V_{SS} EXCEPT PINS 2 AND 14 WHICH SHOULD BE LEFT FLOATING.

Fig. 15 - Input leakage-current test circuit.

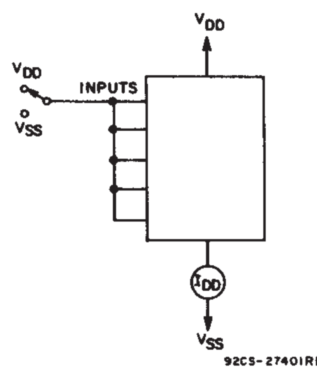


Fig. 16 - Quiescent device current test circuit.

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. 17.

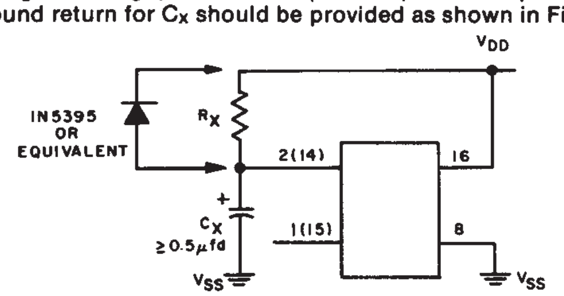


Fig. 17 - Rapid power-down protection circuit.

An alternate protection method is shown in Fig. 18, 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.

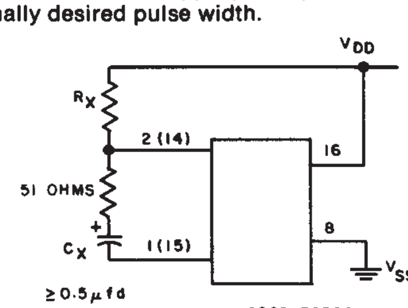
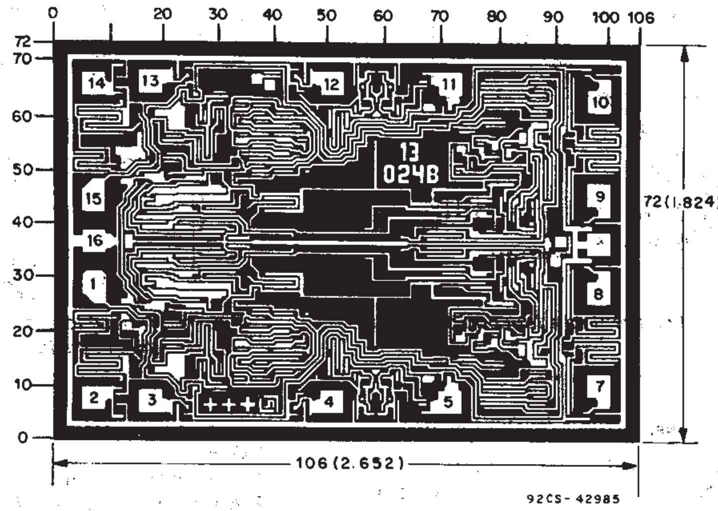


Fig. 18 - Alternate rapid power-down protection circuit.



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

Dimensions and pad layout for CD14538BH.

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