HD14538B

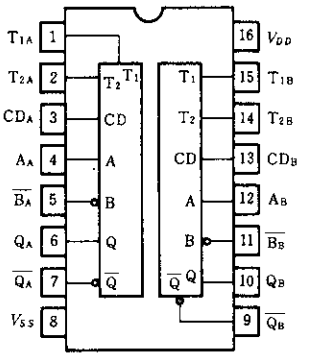
Dual Precision Retriggerable/Resettable Monostable Multivibrator

The HD14538B is a dual, retriggerable, resettable monostable multivibrator. It may be triggered from either edge of an input pulse, and will produce an accurate output pulse over a wide range of widths, the duration and accuracy of which are determined by the external timing components, Cx and Rx. Linear CMOS techniques allow more precise control of output pulse width.

■ FEATURES

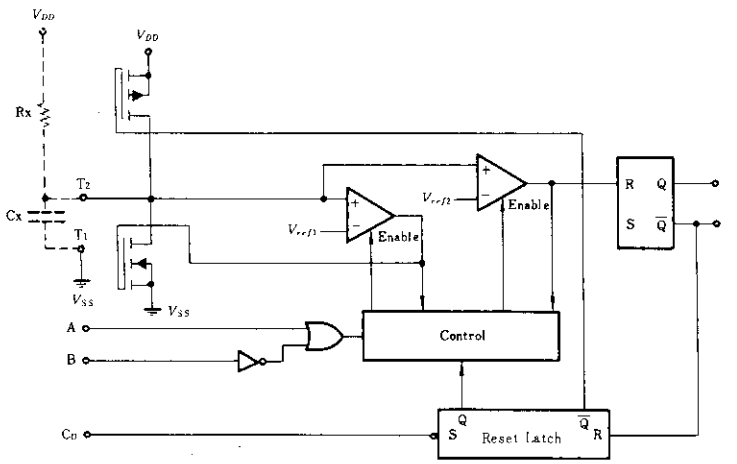
- New Formula: PWout = Rx•Cs
- Pulse Width Range = 10μs to ∞
- Quiescent Current = 5nA/pkg typ. @5V
- 3 to 18V Operational Limits
- Capable of Driving One Low-power Schottky TTL Load Over the Rated Temperature Range
- Pin-for-Pin Compatible with HD14528B

■ PIN ARRANGEMENT

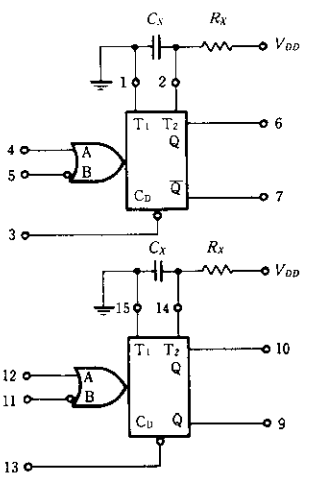


(Top View)

■ LOGIC DIAGRAM (1/2)



■ BLOCK DIAGRAM



Rx and Cx are external components.

V_{DD} = Pin 16

V_{SS} = Pin 1, 8, 15

HITACHI

■ ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	V_{DD}(V)	Test Conditions	−40°C min	−40°C max	25°C min	25°C typ	25°C max	85°C min	85°C max	Unit
Output Voltage	V_{OL}	5.0	$V_{in}=V_{DD}$ or 0	—	0.05	—	0	0.05	—	0.05	V
		10		—	0.05	—	0	0.05	—	0.05	
		15		—	0.05	—	0	0.05	—	0.05	
	V_{OH}	5.0	$V_{in}=0$ or V_{DD}	4.95	—	4.95	5.0	—	4.95	—	V
		10		9.95	—	9.95	10	—	9.95	—	
		15		14.95	—	14.95	15	—	14.95	—	
Input Voltage	V_{IL}	5.0	V_{out}=4.5 or 0.5V	—	1.5	—	2.25	1.5	—	1.5	V
		10	V_{out}=9.0 or 1.0V	—	3.0	—	4.50	3.0	—	3.0	
		15	V_{out}=13.5 or 1.5V	—	4.0	—	6.75	4.0	—	4.0	
	V_{IH}	5.0	V_{out}=0.5 or 4.5V	3.5	—	3.5	2.75	—	3.5	—	V
		10	V_{out}=1.0 or 9.0V	7.0	—	7.0	5.50	—	7.0	—	
		15	V_{out}=1.5 or 13.5V	11.0	—	11.0	8.25	—	11.0	—	
Output Drive Current	I_{OH}	5.0	V_{OH}=2.5V	−2.5	—	−2.1	−4.2	—	−1.7	—	mA
		5.0	V_{OH}=4.6V	−0.52	—	−0.44	−0.88	—	−0.36	—	
		10	V_{OH}=9.5V	−1.3	—	−1.1	−2.25	—	−0.9	—	
		15	V_{OH}=13.5V	−3.6	—	−3.0	−8.8	—	−2.4	—	
	I_{OL}	5.0	V_{OL}=0.4V	0.52	—	0.44	0.88	—	0.36	—	mA
		10	V_{OL}=0.5V	1.3	—	1.1	2.25	—	0.9	—	
		15	V_{OL}=1.5V	3.6	—	3.0	8.8	—	2.4	—	
Input Current	I_{in}	15		—	±0.3	—	±0.00001	±0.3	—	±1.0	μA
Input Capacitance	C_{in}	—	V_{in}=0	—	—	—	5.0	7.5	—	—	pF
Quiescent Current	I_{DD}	5.0	Zero Signal, per Package	—	20	—	0.005	20	—	150	μA
		10		—	40	—	0.010	40	—	300	
		15		—	80	—	0.015	80	—	600	
Total Supply Current*	I_T	$I_T(5.0V)=(3.5\times10^{-2})Rx\cdot Cx\cdot f+4Cx\cdot f+1\times10^{-5}C_L\cdot f$									μA
		$I_T(10V)=(8\times10^{-2})Rx\cdot Cx\cdot f+9Cx\cdot f+2\times10^{-5}C_L\cdot f$									
		$I_T(15V)=(1.25\times10^{-1})Rx\cdot Cx\cdot f+12Cx\cdot f+3\times10^{-5}C_L\cdot f$									

I_T : μA, Cx : μF, C_L : pF, Rx : kΩ, f : Hz

■ SWITCHING CHARACTERISTICS (C_L=50pF, Ta=25°C)

Characteristic		Symbol	Cx	Rx(kΩ)	V_{DD}(V)	min	typ	max	Unit
Output Rise Time		t_r	—	—	5.0	—	100	200	ns
					10	—	50	100	
					15	—	40	80	
Output Fall Time		t_f	—	—	5.0	—	100	200	ns
					10	—	50	100	
					15	—	40	80	
Propagation Delay Time	A, B to Q, $\overline{Q}$	t_{PLH}, t_{PHL}	—	—	5.0	—	300	600	ns
					10	—	150	300	
					15	—	100	220	
	C_D to Q, $\overline{Q}$		—	—	5.0	—	250	500	
					10	—	125	250	
					15	—	95	190	
Minimum Input Pulse Width		$PWin$	—	—	5.0	100	50	—	ns
					10	60	30	—	
					15	50	25	—	
Output Pulse Width		$PWout$	0.002μF	100kΩ	5.0	185	200	215	μs
					10	185	200	215	
					15	185	200	215	
			0.1μF	100kΩ	5.0	8.8	9.4	10.0	ms
					10	8.8	9.4	10.0	
					15	8.8	9.4	10.0	
			10μF	100kΩ	5.0	0.915	0.965	1.015	s
					10	0.915	0.965	1.015	
					15	0.915	0.965	1.015	
Minimum Retrigger Time		t_{rr}	—	—	5.0	0	—	—	ns
					10	0	—	—	
					15	0	—	—	
External Timing Resistance		Rx	—	—	—	5.0	—	OPEN	kΩ
External Timing Capacitance		Cx	—	—	—	2000	—	No Limit	pF

■ APPLICATIONS

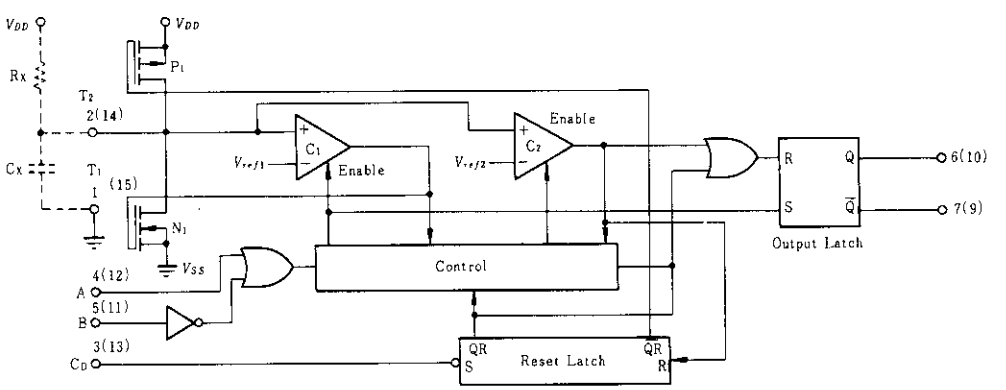


Fig.1 Logic Diagram

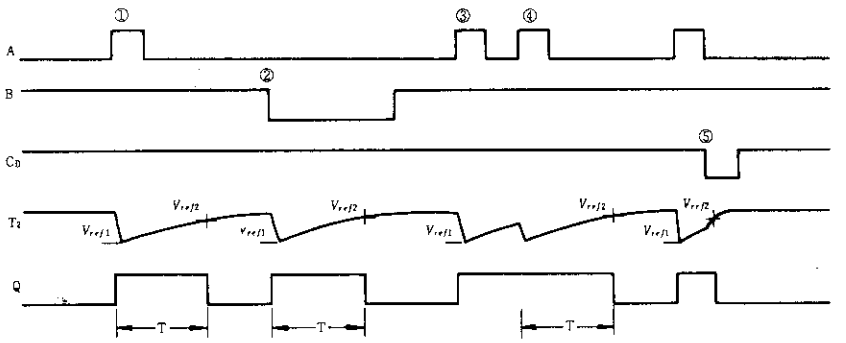


Fig. 2 Timing Operation

■ TRIGGER OPERATION

The block diagram of the HD14538B is shown in Figure 1, with circuit operation following. As shown in Figures 1 and 2 before an input trigger occurs, the monostable is in the quiescent state with the Q output low, and the timing capacitor Cx completely charged to V_{DD}. When the trigger input A goes from V_{SS} to V_{DD} (while inputs B and C_D are held to V_{DD}) a valid trigger is recognized, which turns on comparator C1 and N-Channel transistor N1 ①.

At the same time the output latch is set. With transistor N1 on, the capacitor Cx rapidly discharges toward V_{SS} until Vref1 is reached. At this point the output of comparator C1 changes state and transistor N1 turns off. Comparator C1 then turns off while at the same time comparator C2 turns on. With transistor N1 off, the capacitor Cx begins to charge through the timing resistor, Rx, toward V_{DD}. When the voltage across Cx equals Vref2, comparator C2 changes state, causing the output latch to reset (Q goes low) while at the same time disabling comparator C2 ②.

This ends the timing cycle with the monostable in the quiescent state, waiting for the next trigger. It should be noted that in the quiescent state Cx is full charged to V_{DD} causing the current through resistor Rx to be zero. Both comparators are "off" with the total device current due only to reverse junction leakages.

An added feature of the HD14538B is that the output latch is set via the input trigger with out regard to the capacitor voltage. Thus, propagation delay from trigger to Q is independent of the value of Cx, Rx, or the duty cycle of the input waveform.

■ RETRIGGER OPERATION

The HD14538B is retriggered if a valid trigger occurs ③ followed by another valid trigger 4 before the Q output has returned to the quiescent (zero) state. Any retrigger, after the timing node voltage at pin 2 or 14 has begun to rise from Vref1, but has not yet reached Vref2, will cause an increase in output pulse width T. When a valid retrigger is initiated ④, the voltage at T2 will again drop to Vref1 before progressing along the RC charging curve toward V_{DD}.

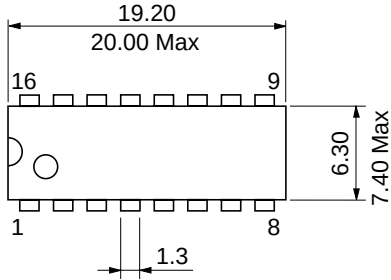
The Q output will remain high until time T, after the last valid retrigger.

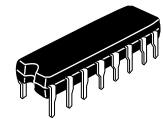
■ RESET OPERATION

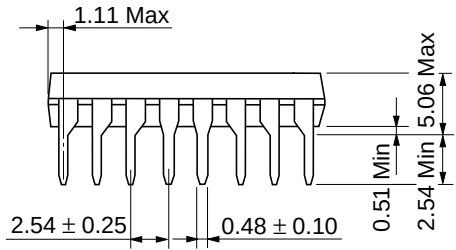
The HD14538B may be reset during the generation of the output pulse. In the reset mode of operation, an input pulse on C_D sets the reset latch and causes the capacitor to be fast charged to V_{DD} by turning on transistor P1 ⑤.

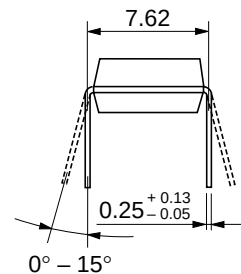
When the voltage on the capacitor reaches Vref2, the reset latch will clear, and will then be ready to accept another pulse. If the C_D input is held low, any trigger inputs that occur will be inhibited and the Q and $\bar{Q}$ outputs of the output latch will not change. Since the Q output is reset when an input low level is detected on the C_D input, the output pulse T can be made significantly shorter than the minimum pulse width specification.

Unit: mm



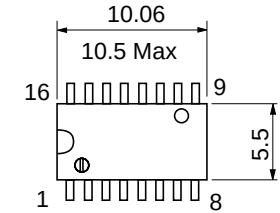


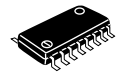


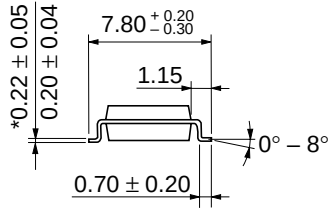


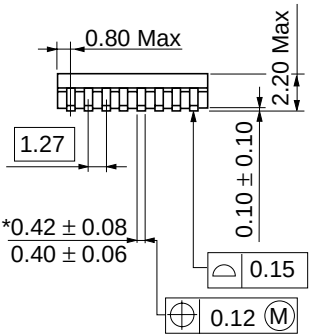
Hitachi Code	DP-16
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	1.07 g

Unit: mm





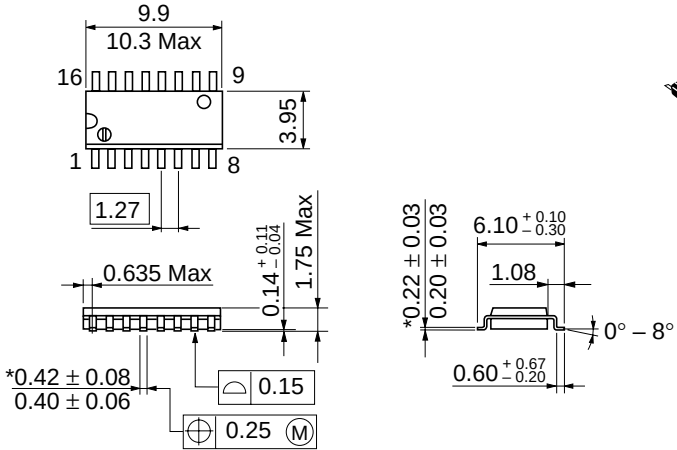


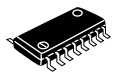


*Dimension including the plating thickness
Base material dimension

Hitachi Code	FP-16DA
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.24 g

Unit: mm





Hitachi Code	FP-16DN
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	0.15 g

*Dimension including the plating thickness
Base material dimension

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HITACHI

Hitachi, Ltd.
Semiconductor & Integrated Circuits.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

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For further information write to:

Hitachi Semiconductor
(America) Inc.
179 East Tasman Drive,
San Jose,CA 95134
Tel: <1> (408) 433-1990
Fax: <1>(408) 433-0223

Hitachi Europe GmbH
Electronic components Group
Dornacher Straße 3
D-85622 Feldkirchen, Munich
Germany
Tel: <49> (89) 9 9180-0
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.
Electronic Components Group.
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA, United Kingdom
Tel: <44> (1628) 585000
Fax: <44> (1628) 778322

Hitachi Asia Pte. Ltd.
16 Collyer Quay #20-00
Hitachi Tower
Singapore 049318
Tel: 535-2100
Fax: 535-1533

Hitachi Asia Ltd.
Taipei Branch Office
3F, Hung Kuo Building. No.167,
Tun-Hwa North Road, Taipei (105)
Tel: <886> (2) 2718-3666
Fax: <886> (2) 2718-8180

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower, World Finance Centre,
Harbour City, Canton Road, Tsim Sha Tsui,
Kowloon, Hong Kong
Tel: <852> (2) 735 9218
Fax: <852> (2) 730 0281
Telex: 40815 HITEC HX