

October 1987 Revised March 2002

### **CD4047BC**

# Low Power Monostable/Astable Multivibrator

## **General Description**

The CD4047B is capable of operating in either the monostable or astable mode. It requires an external capacitor (between pins 1 and 3) and an external resistor (between pins 2 and 3) to determine the output pulse width in the monostable mode, and the output frequency in the astable mode.

Astable operation is enable<u>d by a high</u> level on the astable input or low level on the astable input. The output frequency (at 50% duty cycle) at Q and  $\overline{Q}$  outputs is determined by the timing components. A frequency twice that of Q is available at the Oscillator Output; a 50% duty cycle is not guaranteed.

Monostable operation is obtained when the device is triggered by LOW-to-HIGH transition at + trigger input or HIGH-to-LOW transition at - trigger input. The device can be retriggered by applying a simultaneous LOW-to-HIGH transition to both the + trigger and retrigger inputs.

A high level on Reset input resets the outputs Q to LOW,  $\overline{\mathbf{Q}}$  to HIGH.

#### **Features**

■ Wide supply voltage range: 3.0V to 15V■ High noise immunity: 0.45 V<sub>DD</sub> (typ.)

■ Low power TTL compatibility: Fan out of 2 driving 74L or 1 driving 74LS

#### Special Features

- Low power consumption: special CMOS oscillator configuration
- Monostable (one-shot) or astable (free-running)
- True and complemented buffered outputs
- Only one external R and C required

#### Monostable Multivibrator Features

- Positive- or negative-edge trigger
- Output pulse width independent of trigger pulse duration
- Retriggerable option for pulse width expansion
- Long pulse widths possible using small RC components by means of external counter provision
- Fast recovery time essentially independent of pulse width
- Pulse-width accuracy maintained at duty cycles approaching 100%

#### **Astable Multivibrator Features**

- Free-running or gatable operating modes
- 50% duty cycle
- Oscillator output available
- Good astable frequency stability typical= ±2% + 0.03%/°C @ 100 kHz frequency= ±0.5% + 0.015%/°C @ 10 kHz deviation (circuits trimmed to frequency V<sub>DD</sub> = 10V ±10%)

# **Applications**

- Frequency discriminators
- · Timing circuits
- Time-delay applications
- Envelope detection
- · Frequency multiplication
- Frequency division

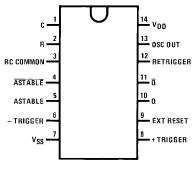
# **Ordering Code:**

Order Number	Package Number	Package Description
CD4047BCM	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
CD4047BCN	N14A	14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

# **Connection Diagram**

#### Pin Assignments for SOIC and DIP



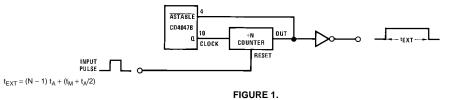
**Top View** 

# **Function Table**

	Terminal Connections			Output Pulse	Typical Output	
Function	To V <sub>DD</sub>	To V <sub>SS</sub>	Input Pulse	From	Period or	
			То		Pulse Width	
Astable Multivibrator						
Free-Running	4, 5, 6, 14	7, 8, 9, 12		10, 11, 13	t <sub>A</sub> (10, 11) = 4.40 RC	
True Gating	4, 6, 14	7, 8, 9, 12	5	10, 11, 13	t <sub>A</sub> (13) = 2.20 RC	
Complement Gating	6, 14	5, 7, 8, 9, 12	4	10, 11, 13		
Monostable Multivibrator						
Positive-Edge Trigger	4, 14	5, 6, 7, 9, 12	8	10, 11		
Negative-Edge Trigger	4, 8, 14	5, 7, 9, 12	6	10, 11	t <sub>M</sub> (10, 11) = 2.48 RC	
Retriggerable	4, 14	5, 6, 7, 9	8, 12	10, 11		
External Countdown (Note 1)	14	5, 6, 7, 8, 9, 12	Figure 1	Figure 1	Figure 1	

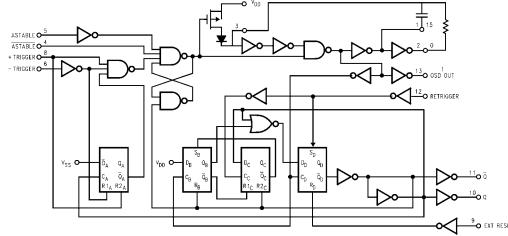
Note 1: External resistor between terminals 2 and 3. External capacitor between terminals 1 and 3.

# **Typical Implementation of External Countdown Option**



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# **Logic Diagram**



 ${}^\star \text{Special}$  input protection circuit to permit larger input-voltage swings.

# Absolute Maximum Ratings(Note 2)

(Note 3)

DC Supply Voltage (V<sub>DD</sub>)  $-0.5 \text{V to } +18 \text{V}_{DC}$  Input Voltage (V<sub>IN</sub>)  $-0.5 \text{V to } \text{V}_{DD} +0.5 \text{V}_{DC}$ 

Storage Temperature Range (T<sub>S</sub>)  $-65^{\circ}$ C to +150 $^{\circ}$ C

Power Dissipation (P<sub>D</sub>)

Dual-In-Line 700 mW Small Outline 500 mW

Lead Temperature (T<sub>L</sub>)

(Soldering, 10 seconds) 260°C

# Recommended Operating Conditions (Note 3)

 $\begin{array}{ll} \text{DC Supply Voltage (V}_{\text{DD}}) & 3\text{V to } 15\text{V}_{\text{DC}} \\ \text{Input Voltage (V}_{\text{IN}}) & 0 \text{ to } \text{V}_{\text{DD}} \text{V}_{\text{DC}} \\ \text{Operating Temperature Range (T}_{\text{A}}) & -55^{\circ}\text{C to } +125^{\circ}\text{C} \end{array}$ 

Note 2: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of "Recom-

mended Operating Conditions" and "Electrical Characteristics" provides conditions for actual device operation.

Note 3:  $V_{SS} = 0V$  unless otherwise specified.

# **DC Electrical Characteristics** (Note 3)

Cumhal	Parameter	Conditions	–55°C		25°C		125°C		Units	
Symbol		Conditions	Min	Max	Min	Тур	Max	Min	Max	Units
I <sub>DD</sub>	Quiescent Device Current	$V_{DD} = 5V$		5			5		150	
		$V_{DD} = 10V$		10			10		300	μΑ
		$V_{DD} = 15V$		20			20		600	
V <sub>OL</sub>	LOW Level Output Voltage	I <sub>O</sub>   < 1 μA								
		$V_{DD} = 5V$		0.05		0	0.05		0.05	
		$V_{DD} = 10V$		0.05		0	0.05		0.05	V
		$V_{DD} = 15V$		0.05		0	0.05		0.05	
V <sub>OH</sub>	HIGH Level Output Voltage	I <sub>O</sub>   < 1 μA								
		$V_{DD} = 5V$	4.95		4.95	5		4.95		
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
		$V_{DD} = 15V$	14.95		14.95	15		14.95		
V <sub>IL</sub>	LOW Level Input Voltage	$V_{DD} = 5V, V_{O} = 0.5V \text{ or } 4.5V$		1.5		2.25	1.5		1.5	
		$V_{DD} = 10V, V_{O} = 1V \text{ or } 9V$		3.0		4.5	3.0		3.0	V
		$V_{DD} = 15V, V_{O} = 1.5V \text{ or } 13.5V$		4.0		6.75	4.0		4.0	
V <sub>IH</sub>	HIGH Level Input Voltage	$V_{DD} = 5V, V_{O} = 0.5V \text{ or } 4.5V$	3.5		3.5	2.75		3.5		
		$V_{DD} = 10V$ , $V_O = 1V$ or $9V$	7.0		7.0	5.5		7.0		V
		$V_{DD} = 15V, V_{O} = 1.5V \text{ or } 13.5V$	11.0		11.0	8.25		11.0		
l <sub>OL</sub>	LOW Level Output Current	$V_{DD} = 5V, V_{O} = 0.4V$	0.64		0.51	0.88		0.36		
	(Note 4)	$V_{DD} = 10V, V_{O} = 0.5V$	1.6		1.3	2.25		0.9		mA
		$V_{DD} = 15V, V_{O} = 1.5V$	4.2		3.4	8.8		2.4		
I <sub>ОН</sub>	HIGH Level Output Current	$V_{DD} = 5V, V_{O} = 4.6V$	-0.64		-0.51	-0.88		-0.36		
	(Note 4)	$V_{DD} = 10V, V_{O} = 9.5V$	-1.6		-1.3	-2.25		-0.9		mA
		$V_{DD} = 15V, V_{O} = 13.5V$	-4.2		-3.4	-8.8		-2.4		
I <sub>IN</sub>	Input Current	$V_{DD} = 15V, V_{IN} = 0V$		-0.1		-10 <sup>-5</sup>	-0.1		-1.0	μА
		$V_{DD} = 15V, V_{IN} = 15V$		0.1		10 <sup>-5</sup>	0.1		1.0	μΑ

Note 4: I<sub>OH</sub> and I<sub>OL</sub> are tested one output at a time.

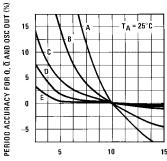
# AC Electrical Characteristics (Note 5) $T_A = 25^{\circ}\text{C, C}_L = 50 \text{ pF, R}_L = 200\text{k, input t}_r = t_f = 20 \text{ ns, unless otherwise specified.}$

Symbol	Parameter	Conditions	Min	Тур	Max	Units
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay Time Astable,	$V_{DD} = 5V$		200	400	
	Astable to Osc Out	$V_{DD} = 10V$		100	200	ns
		$V_{DD} = 15V$		80	160	
t <sub>PHL</sub> , t <sub>PLH</sub>	Astable, Astable to Q, Q	$V_{DD} = 5V$		550	900	
		V <sub>DD</sub> = 10V		250	500	ns
		V <sub>DD</sub> = 15V		200	400	
t <sub>PHL</sub> , t <sub>PLH</sub>	+ Trigger, - Trigger to Q	V <sub>DD</sub> = 5V		700	1200	
		V <sub>DD</sub> = 10V		300	600	ns
		$V_{DD} = 15V$		240	480	
t <sub>PHL</sub> , t <sub>PLH</sub>	+ Trigger, Retrigger to Q	V <sub>DD</sub> = 5V		300	600	
		V <sub>DD</sub> = 10V		175	300	ns
		$V_{DD} = 15V$		150	250	
t <sub>PHL</sub> , t <sub>PLH</sub>	Reset to Q, Q	V <sub>DD</sub> = 5V		300	600	
		$V_{DD} = 10V$		125	250	ns
		$V_{DD} = 15V$		100	200	
t <sub>THL</sub> , t <sub>TLH</sub>	Transition Time Q, Q, Osc Out	V <sub>DD</sub> = 5V		100	200	
		V <sub>DD</sub> = 10V		50	100	ns
		$V_{DD} = 15V$		40	80	
t <sub>WL</sub> , t <sub>WH</sub>	Minimum Input Pulse Duration	Any Input				
		$V_{DD} = 5V$		500	1000	
		$V_{DD} = 10V$		200	400	ns
		$V_{DD} = 15V$		160	320	
t <sub>RCL</sub> , t <sub>FCL</sub>	+ Trigger, Retrigger, Rise and	$V_{DD} = 5V$			15	
	Fall Time	$V_{DD} = 10V$			5	μs
		$V_{DD} = 15V$			5	
C <sub>IN</sub>	Average Input Capacitance	Any Input		5	7.5	pF

Note 5: AC Parameters are guaranteed by DC correlated testing.

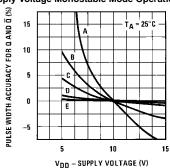
# **Typical Performance Characteristics**

Typical Q, Q, Osc Out Period Accuracy vs Supply Voltage (Astable Mode Operation)



V<sub>DD</sub> - SUPPLY VOLTAGE (V)

Typical Q, Q, Pulse Width Accuracy vs **Supply Voltage Monostable Mode Operation** 



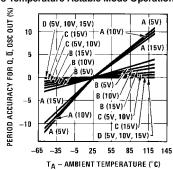
	f <sub>Q</sub> , Q	R	С
Α	1000 kHz	22k	10 pF
В	100 kHz	22k	100 pF
С	10 kHz	220k	100 pF
D	1 kHz	220k	1000 pF
Ε	100 Hz	2.2M	1000 pF

В

D

С 10 pF 2 μs 22k 22k 100 pF 7 μs 220k 100 pF 550 μs 220k 1000 pF 2.2M 1000 pF 5.5 ms

Typical Q, Q and Osc Out Period Accuracy vs Temperature Astable Mode Operation



 $f_Q, \overline{Q}$ С R

10 pF

100 pF

100 pF

1000 pF

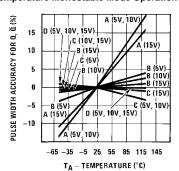
22k

100 kHz 22k 10 kHz 220k 1 kHz 220k

Note: Minimum Value of R:  $10 \text{ K} \Omega$ 

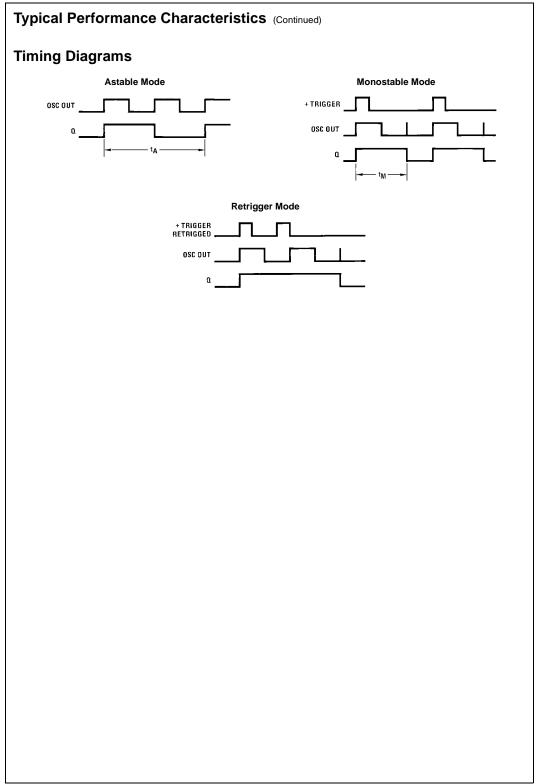
Maximum Value of R: 1 Meg  $\Omega$ Minimum Value of C for Astable Mode: 100 pF Minimum Value of C for Monostable Mode: 1000 pF

Typical Q and Q Pulse Width Accuracy vs **Temperature Monostable Mode Operation** 



	·М	K	C
Α	2 μs	22k	10 pF
В	7 μs	22k	100 pF
С	60 μs	220k	100 pF
D	550 us	220k	1000 p

1000 kHz



# Physical Dimensions inches (millimeters) unless otherwise noted $\frac{0.335 - 0.344}{(8.509 - 8.738)}$ LEAD NO. 1 IDENT 0.010 MAX (0.254) $\frac{0.150 - 0.157}{(3.810 - 3.988)}$ $\frac{0.053 - 0.069}{(1.346 - 1.753)}$ $\frac{0.010 - 0.020}{(0.254 - 0.508)}$ 8° MAX TYP ALL LEADS $\frac{0.004 - 0.010}{(0.102 - 0.254)}$ SEATING PLANE 0.014 0.008 - 0.010 (0.203 - 0.254) TYP ALL LEADS 0.050 (1.270) TYP $\frac{0.014 - 0.020}{(0.356 - 0.508)} \text{ TYP}$ 0.016 - 0.050 (0.406 - 1.270) TYP ALL LEADS

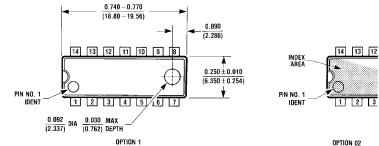
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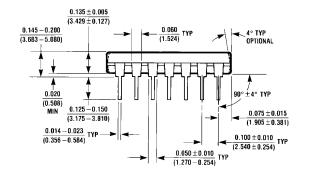
0.008 (0.203) TYP

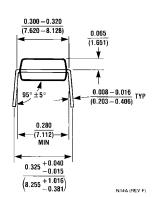
M14A (REV h)

0.004 (0.102) ALL LEAD TIPS

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)







14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide Package Number N14A

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