

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 enabled by a high level on the astable input or low level on the astable input. The output frequency (at 50% duty cycle) at Q and \bar{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, \bar{Q} to HIGH.

Features

- Wide supply voltage range: 3.0V to 15V
- High noise immunity: $0.45 V_{DD}$ (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) operation
- 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 = $\pm 2\% + 0.03\%/^{\circ}\text{C}$ @ 100 kHz
frequency = $\pm 0.5\% + 0.015\%/^{\circ}\text{C}$ @ 10 kHz
deviation (circuits trimmed to frequency $V_{DD} = 10\text{V}$ $\pm 10\%$)

Applications

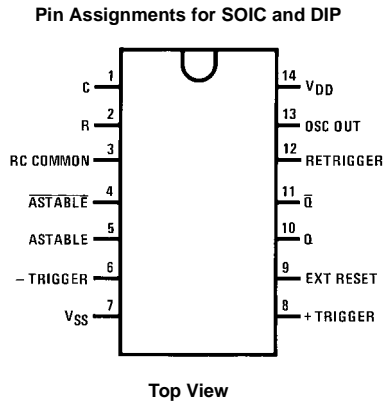
- Frequency discriminators
- Timing circuits
- Time-delay applications
- Envelope detection
- Frequency multiplication
- Frequency division

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

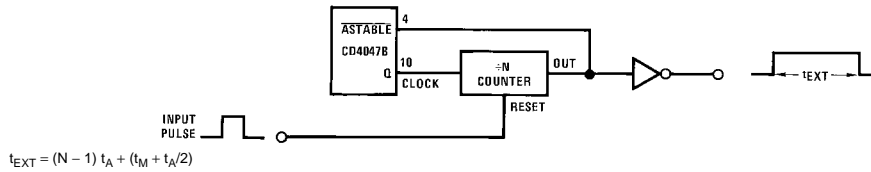


Function Table

Function	Terminal Connections			Output Pulse From	Typical Output Period or Pulse Width
	To V _{DD}	To V _{SS}	Input Pulse To		
Astable Multivibrator					
Free-Running	4, 5, 6, 14	7, 8, 9, 12		10, 11, 13	$t_A(10, 11) = 4.40 RC$
True Gating	4, 6, 14	7, 8, 9, 12	5	10, 11, 13	$t_A(13) = 2.20 RC$
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	$t_M(10, 11) = 2.48 RC$
Negative-Edge Trigger	4, 8, 14	5, 7, 9, 12	6	10, 11	
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

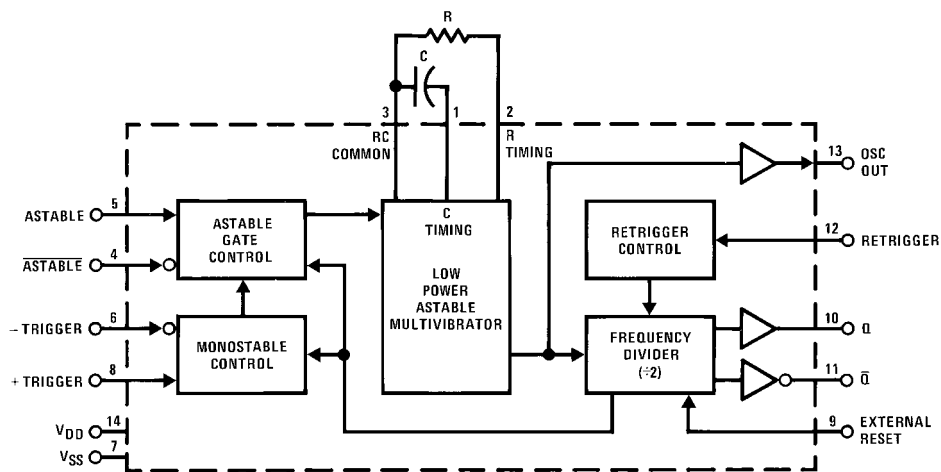
Note 1: External resistor between terminals 2 and 3. External capacitor between terminals 1 and 3.

Typical Implementation of External Countdown Option

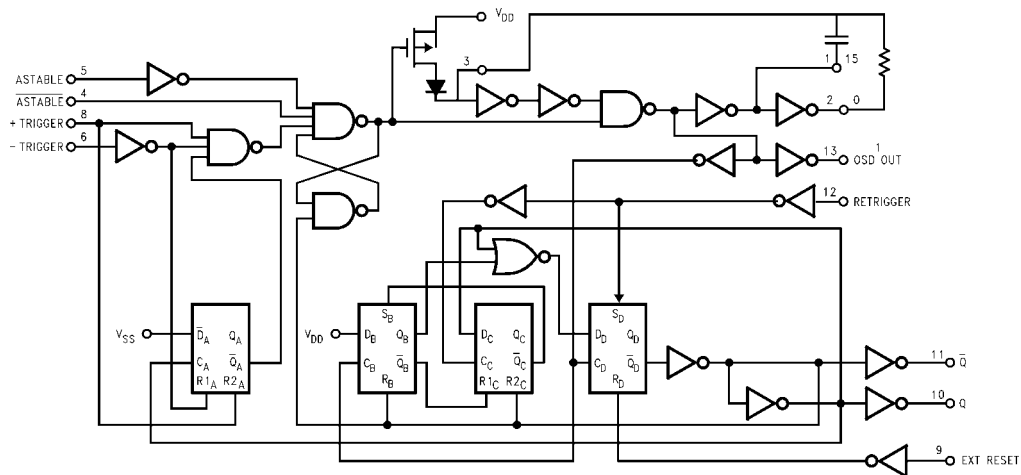


$$t_{EXT} = (N - 1) t_A + (t_M + t_A/2)$$

Block Diagram



Logic Diagram



*Special input protection circuit to permit larger input-voltage swings.

Absolute Maximum Ratings (Note 2)

(Note 3)

DC Supply Voltage (V_{DD})	-0.5V to +18V _{DC}
Input Voltage (V_{IN})	-0.5V to V_{DD} + 0.5V _{DC}
Storage Temperature Range (T_S)	-65°C to +150°C
Power Dissipation (P_D)	
Dual-In-Line	700 mW
Small Outline	500 mW
Lead Temperature (T_L)	
(Soldering, 10 seconds)	260°C

Recommended Operating Conditions (Note 3)

DC Supply Voltage (V_{DD})	3V to 15V _{DC}
Input Voltage (V_{IN})	0 to V_{DD} V _{DC}
Operating Temperature Range (T_A)	-55°C to +125°C

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

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

DC Electrical Characteristics (Note 3)

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

Note 4: I_{OH} and I_{OL} are tested one output at a time.

AC Electrical Characteristics (Note 5)

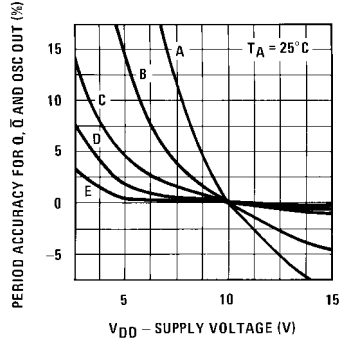
$T_A = 25^\circ\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ k}$, input $t_r = t_f = 20\text{ ns}$, unless otherwise specified.

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

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

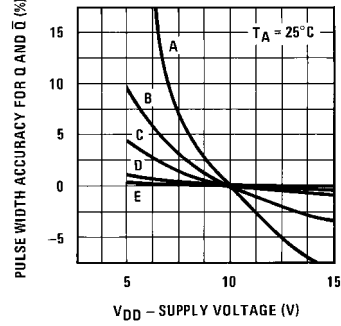
Typical Performance Characteristics

Typical Q, \bar{Q} , Osc Out Period Accuracy vs Supply Voltage (Astable Mode Operation)



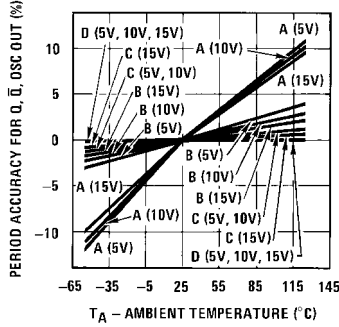
f_Q, \bar{Q}	R	C
A 1000 kHz	22k	10 pF
B 100 kHz	22k	100 pF
C 10 kHz	220k	100 pF
D 1 kHz	220k	1000 pF
E 100 Hz	2.2M	1000 pF

Typical Q, \bar{Q} , Pulse Width Accuracy vs Supply Voltage Monostable Mode Operation



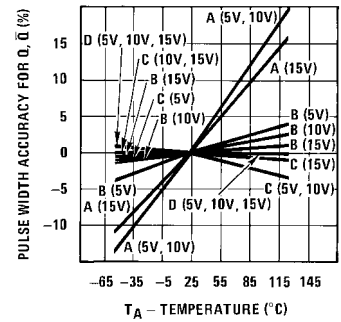
t_M	R	C
A 2 μ s	22k	10 pF
B 7 μ s	22k	100 pF
C 60 μ s	220k	100 pF
D 550 μ s	220k	1000 pF
E 5.5 ms	2.2M	1000 pF

Typical Q, \bar{Q} and Osc Out Period Accuracy vs Temperature Astable Mode Operation



f_Q, \bar{Q}	R	C
A 1000 kHz	22k	10 pF
B 100 kHz	22k	100 pF
C 10 kHz	220k	100 pF
D 1 kHz	220k	1000 pF

Typical Q and \bar{Q} Pulse Width Accuracy vs Temperature Monostable Mode Operation

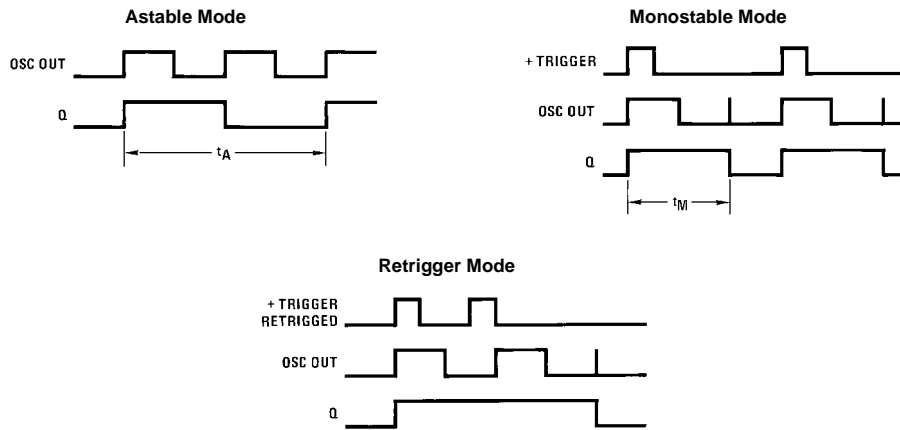


t_M	R	C
A 2 μ s	22k	10 pF
B 7 μ s	22k	100 pF
C 60 μ s	220k	100 pF
D 550 μ s	220k	1000 pF

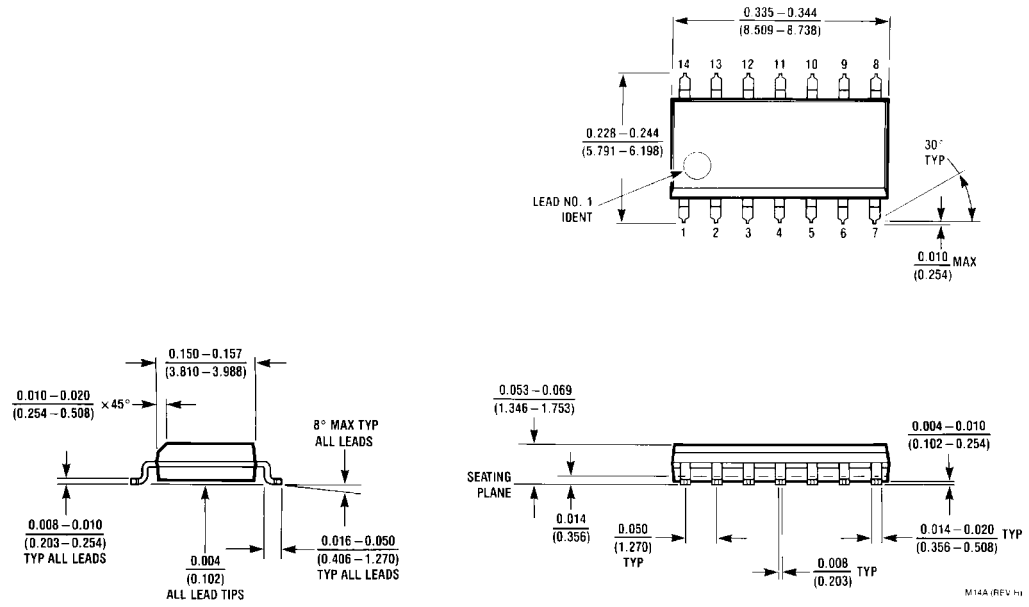
Note: Minimum Value of R: 10 K Ω
 Maximum Value of R: 1 Meg Ω
 Minimum Value of C for Astable Mode: 100 pF
 Minimum Value of C for Monostable Mode: 1000 pF

Typical Performance Characteristics (Continued)

Timing Diagrams



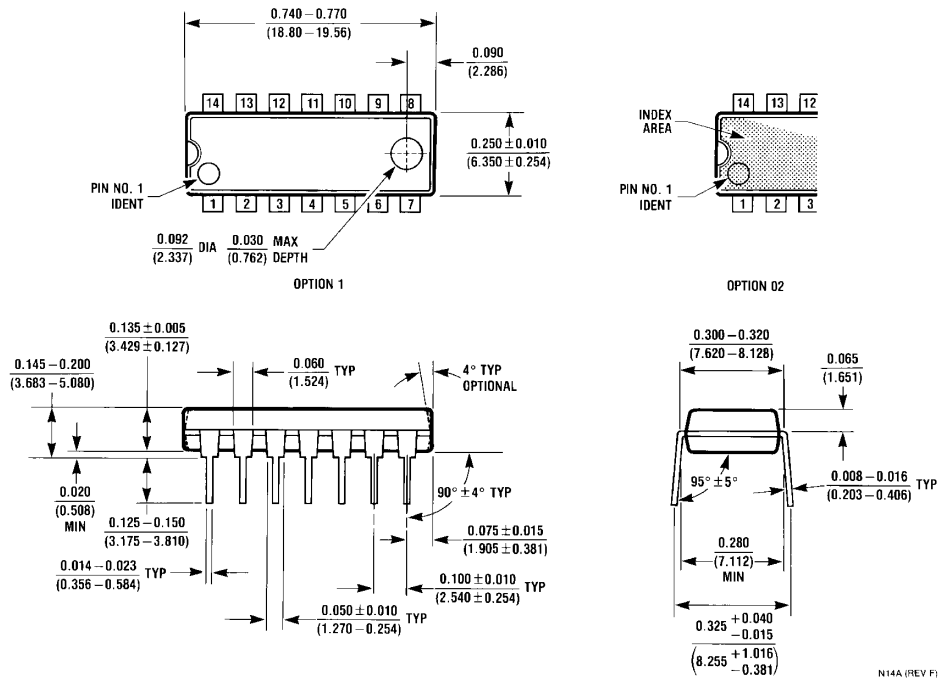
Physical Dimensions inches (millimeters) unless otherwise noted



14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Package Number M14A

M14A (REV. H)

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

N14A (REV F)

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