## CD4020BM/CD4020BC 14-Stage Ripple Carry Binary Counters CD4040BM/CD4040BC 12-Stage Ripple Carry Binary Counters CD4060BM/CD4060BC 14-Stage Ripple Carry Binary Counters

### **General Description**

The CD4020BM/CD4020BC, CD4060BM/CD4060BC are 14-stage ripple carry binary counters, and the CD4040BM/CD4040BC is a 12-stage ripple carry binary counter. The counters are advanced one count on the negative transition of each clock pulse. The counters are reset to the zero state by a logical "1" at the reset input independent of clock.

#### **Features**

- Wide supply voltage range
- High noise immunity
- Low power TTL compatibility
- Medium speed operation
- Schmitt trigger clock input

1.0V to 15V

CD4020BM/BC 14-Stage Ripple Carry Binary Counters/CD4040BM/BC 12-Stage Ripple Carry Binary Counters CD4060BM/BC 14-Stage Ripple Carry Binary Counters

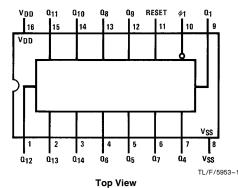
 $0.45~V_{DD}$  (typ.) Fan out of 2 driving 74L

or 1 driving 74LS

8 MHz typ. at  $V_{DD} = 10V$ 

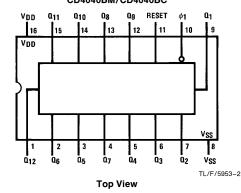
### **Connection Diagrams**

# Dual-In-Line Package CD4020BM/CD4020BC

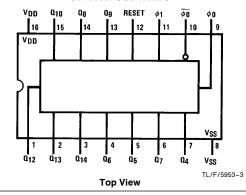


Order Number CD4020B, CD4040B or CD4060B

# Dual-In-Line Package CD4040BM/CD4040BC



#### Dual-In-Line Package CD4060BM/CD4060BC



### Absolute Maximum Ratings (Notes 1 and 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V<sub>DD</sub>) -0.5V to +18V Input Voltage (V<sub>IN</sub>) -0.5V to V<sub>DD</sub> +0.5V Storage Temperature Range (T<sub>S</sub>) -65°C to +150°C

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

Lead Temperature (T<sub>L</sub>) (Soldering, 10 seconds)

# Recommended Operating Conditions

 $\label{eq:Supply Voltage (VDD)} \begin{array}{ll} \text{Supply Voltage (VDD)} & +3\text{V to } +15\text{V} \\ \text{Input Voltage (VIN)} & \text{OV to VDD} \end{array}$ 

 Operating Temperature Range (T<sub>A</sub>)
 -55°C to +125°C

 CD40XXBM
 -55°C to +85°C

 CD40XXBC
 -40°C to +85°C

### DC Electrical Characteristics CD40XXBM (Note 2)

Symbol	Parameter	Conditions	−55°C		+ 25°C		+ 129		5°C	Units
	1 di dilicici	Conditions	Min	Max	Min	Тур	Max	Min	Max	
I <sub>DD</sub>	Quiescent Device Current	$V_{DD} = 5V, V_{IN} = V_{DD} \text{ or } V_{SS}$ $V_{DD} = 10V, V_{IN} = V_{DD} \text{ or } V_{SS}$ $V_{DD} = 15V, V_{IN} = V_{DD} \text{ or } V_{SS}$		5 10 20			5 10 20		150 300 600	μΑ μΑ μΑ
V <sub>OL</sub>	Low Level Output Voltage	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		0.05 0.05 0.05		0 0 0	0.05 0.05 0.05		0.05 0.05 0.05	V V V
V <sub>OH</sub>	High Level Output Voltage	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V	4.95 9.95 14.95		4.95 9.95 14.95	5 10 15		4.95 9.95 14.95		V V
V <sub>IL</sub>	Low Level Input Voltage	$V_{DD} = 5V$ , $V_{O} = 0.5V$ or 4.5V $V_{DD} = 10V$ , $V_{O} = 1.0V$ or 9.0V $V_{DD} = 15V$ , $V_{O} = 1.5V$ or 13.5V		1.5 3.0 4.0		2 4 6	1.5 3.0 4.0		1.5 3.0 4.0	V V
V <sub>IH</sub>	High Level Input Voltage	$V_{DD} = 5V, V_{O} = 0.5V \text{ or } 4.5V \ V_{DD} = 10V, V_{O} = 1.0V \text{ or } 9.0V \ V_{DD} = 15V, V_{O} = 1.5V \text{ or } 13.5V$	3.5 7.0 11.0		3.5 7.0 11.0	3 6 9		3.5 7.0 11.0		V V
lor	Low Level Output Current (See Note 3)	$V_{DD} = 5V, V_{O} = 0.4V$ $V_{DD} = 10V, V_{O} = 0.5V$ $V_{DD} = 15V, V_{O} = 1.5V$	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 mA mA
Гон	High Level Output Current (See Note 3)	$V_{DD} = 5V, V_{O} = 4.6V$ $V_{DD} = 10V, V_{O} = 9.5V$ $V_{DD} = 15V, V_{O} = 13.5V$	-0.64 -1.6 -4.2		-0.51 -1.3 -3.4			-0.36 -0.9 -2.4		mA mA mA
I <sub>IN</sub>	Input Current	$V_{DD} = 15V, V_{IN} = 0V$ $V_{DD} = 15V, V_{IN} = 15V$		-0.10 0.10		-10 <sup>-5</sup>	-0.10 0.10		-1.0 1.0	μA μA

260°C

Note 1: "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 tables of "Recommended Operating Conditions" and "Electrical Characteristics" provide conditions for actual device operation.

Note 2:  $V_{SS} = 0V$  unless otherwise specified.

Note 3: Data does not apply to oscillator points  $\phi_0$  and  $\overline{\phi_0}$  of CD4060BM/CD4060BC.  $I_{OH}$  and  $I_{OL}$  are tested one output at a time.

### DC Electrical Characteristics 40XXBC (Note 2)

Symbol	Parameter	Conditions	-40°C		+ 25°C			+ 85°C		Units
Cy.IIDOI	i diameter	Conditions	Min Max	Min	Тур	Max	Min	Max		
I <sub>DD</sub>	Quiescent Device Current	$V_{DD} = 5V, V_{IN} = V_{DD} \text{ or } V_{SS}$		20			20		150	μΑ
		$V_{DD} = 10V$ , $V_{IN} = V_{DD}$ or $V_{SS}$		40			40		300	μΑ
		$V_{DD} = 15V$ , $V_{IN} = V_{DD}$ or $V_{SS}$		80			80		600	μΑ
V <sub>OL</sub>	Low Level Output Voltage	$V_{DD} = 5V$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$		0.05		0	0.05		0.05	V
		V <sub>DD</sub> = 15V		0.05		0	0.05		0.05	V

### DC Electrical Characteristics 40XXBC (Note 2) (Continued)

Symbol	Parameter	Conditions	-40°C		+ 25°C			+ 85°C		Units
Oymbor	i di dilicici	Conditions	Min	Max	Min	Тур	Max	Min	Max	Oille
V <sub>OH</sub>	High Level Output Voltage	$V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
		$V_{DD} = 15V$	14.95		14.95	15		14.95		V
$V_{IL}$	Low Level Input Voltage	$V_{DD} = 5V, V_{O} = 0.5V \text{ or } 4.5V$		1.5		2	1.5		1.5	V
		$V_{DD} = 10V, V_{O} = 1.0V \text{ or } 9.0V$		3.0		4	3.0		3.0	V
		$V_{DD} = 15V, V_{O} = 1.5V \text{ or } 13.5V$		4.0		6	4.0		4.0	V
V <sub>IH</sub>	High Level Input Voltage	$V_{DD} = 5V, V_{O} = 0.5V \text{ or } 4.5V$	3.5		3.5	3		3.5		V
		$V_{DD} = 10V, V_{O} = 1.0V \text{ or } 9.0V$	7.0		7.0	6		7.0		V
		$V_{DD} = 15V, V_{O} = 1.5V \text{ or } 13.5V$	11.0		11.0	9		11.0		V
loL	Low Level Output Current	$V_{DD} = 5V, V_{O} = 0.4V$	0.52		0.44	0.88		0.36		mA
	(See Note 3)	$V_{DD} = 10V, V_{O} = 0.5V$	1.3		1.1	2.25		0.9		mA
		$V_{DD} = 15V, V_{O} = 1.5V$	3.6		3.0	8.8		2.4		mA
I <sub>OH</sub>	High Level Output Current	$V_{DD} = 5V, V_{O} = 4.6V$	-0.52		-0.44	-0.88		-0.36		mA
	(See Note 3)	$V_{DD} = 10V, V_{O} = 9.5V$	-1.3		-1.1	-2.25		-0.9		mA
		$V_{DD} = 15V, V_{O} = 13.5V$	-3.6		-3.0	-8.8		-2.4		mA
I <sub>IN</sub>	Input Current	$V_{DD} = 15V, V_{IN} = 0V$		-0.30		-10-5	-0.30		-1.0	μΑ
		$V_{DD} = 15V, V_{IN} = 15V$		0.30		10-5	0.30		1.0	μA

# AC Electrical Characteristics\* CD4020BM/CD4020BC, CD4040BM/CD4040BC $T_{A}=25^{\circ}\text{C},\ C_{L}=50\ \text{pF},\ R_{L}=200\text{k},\ t_{r}=t_{f}=20\ \text{ns, unless otherwise noted}$

Symbol	Parameter	Conditions	Min	Тур	Max	Units
t <sub>PHL1</sub> , t <sub>PLH1</sub>	Propagation Delay Time to Q <sub>1</sub>	$V_{DD} = 5V$		250	550	ns
		$V_{DD} = 10V$		100	210	ns
		$V_{DD} = 15V$		75	150	ns
t <sub>PHL</sub> , t <sub>PLH</sub>	Interstage Propagation Delay Time	$V_{DD} = 5V$		150	330	ns
	from $Q_n$ to $Q_{n+1}$	$V_{DD} = 10V$		60	125	ns
		V <sub>DD</sub> = 15V		45	90	ns
t <sub>THL</sub> , t <sub>TLH</sub>	Transition Time	$V_{DD} = 5V$		100	200	ns
		$V_{DD} = 10V$		50	100	ns
		$V_{DD} = 15V$		40	80	ns
t <sub>WL</sub> , t <sub>WH</sub>	Minimum Clock Pulse Width	$V_{DD} = 5V$		125	335	ns
		$V_{DD} = 10V$		50	125	ns
		$V_{DD} = 15V$		40	100	ns
t <sub>rCL</sub> , t <sub>fCL</sub>	Maximum Clock Rise and Fall Time	$V_{DD} = 5V$			No Limit	ns
		$V_{DD} = 10V$			No Limit	ns
		$V_{DD} = 15V$			No Limit	ns
$f_{CL}$	Maximum Clock Frequency	$V_{DD} = 5V$	1.5	4		MHz
		$V_{DD} = 10V$	4	10		MHz
		$V_{DD} = 15V$	5	12		MHz
t <sub>PHL(R)</sub>	Reset Propagation Delay	$V_{DD} = 5V$		200	450	ns
, , , ,	·	$V_{DD} = 10V$		100	210	ns
		$V_{DD} = 15V$		80	170	ns
t <sub>WH(R)</sub>	Minimum Reset Pulse Width	$V_{DD} = 5V$		200	450	ns
• •		$V_{DD} = 10V$		100	210	ns
		V <sub>DD</sub> = 15V		80	170	ns
C <sub>in</sub>	Average Input Capacitance	Any Input		5	7.5	pF
C <sub>pd</sub>	Power Dissipation Capacitance			50		pF

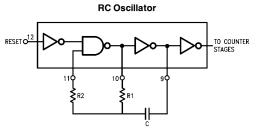
<sup>\*</sup>AC Parameters are guaranteed by DC correlated testing.

# AC Electrical Characteristics\* <code>CD4060BM/CD4060BC</code> $T_A=25^{\circ}\text{C},\ C_L=50\ \text{pF},\ R_L=200\text{k},\ t_r=t_f=20\ \text{ns, unless otherwise noted}$

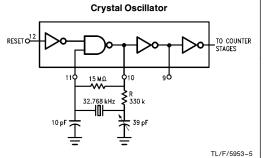
Symbol	Parameter	Conditions	Min	Тур	Max	Units
t <sub>PHL4</sub> , t <sub>PLH4</sub>	Propagation Delay Time to Q <sub>4</sub>	$V_{DD} = 5V$ $V_{DD} = 10V$		550 250	1300 525	ns ns
t <sub>PHL</sub> , t <sub>PLH</sub>	Interstage Propagation Delay Time from $Q_n$ to $Q_{n+1}$	$V_{DD} = 15V$ $V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		200 150 60 45	400 330 125 90	ns ns ns ns
t <sub>THL</sub> , t <sub>TLH</sub>	Transition Time	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		100 50 40	200 100 80	ns ns ns
$t_{WL}$ , $t_{WH}$	Minimum Clock Pulse Width	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		170 65 50	500 170 125	ns ns ns
t <sub>rCL</sub> , t <sub>fCL</sub>	Maximum Clock Rise and Fall Time	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$			No Limit No Limit No Limit	ns ns ns
f <sub>CL</sub>	Maximum Clock Frequency	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$	1 3 4	3 8 10		MHz MHz MHz
t <sub>PHL(R)</sub>	Reset Propagation Delay	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		200 100 80	450 210 170	ns ns ns
t <sub>WH(R)</sub>	Minimum Reset Pulse Width	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		200 100 80	450 210 170	ns ns ns
C <sub>in</sub>	Average Input Capacitance	Any Input		5	7.5	pF
C <sub>pd</sub>	Power Dissipation Capacitance			50		pF

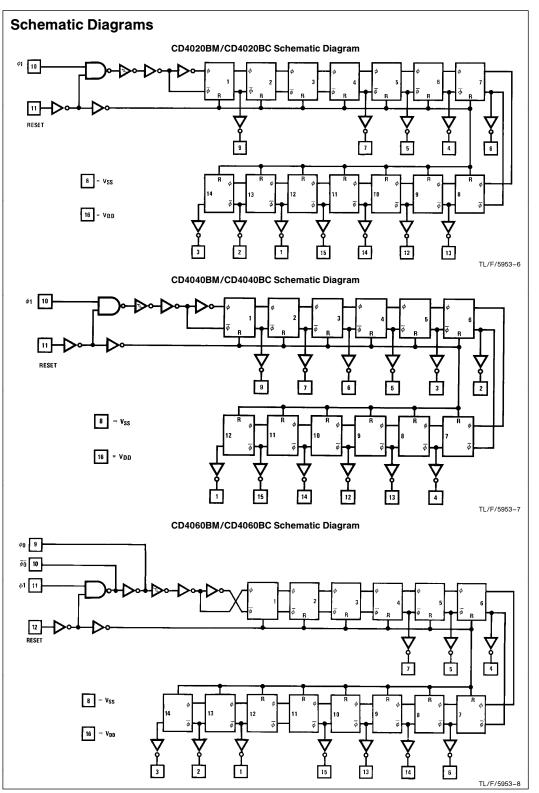
<sup>\*</sup>AC Parameters are guaranteed by DC correlated testing.

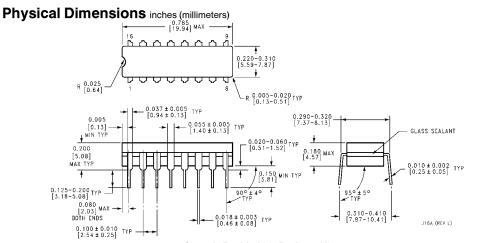
## **CD4060B Typical Oscillator Connections**



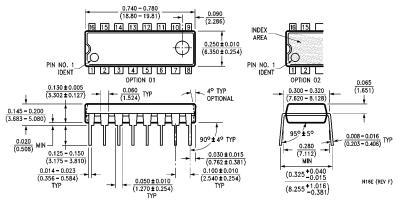
TL/F/5953-4







Ceramic Dual-In-Line Package (J) Order Number CD4020BMJ, CD4020BCJ, CD4040BMJ, CD4040BCJ, CD4060BMJ or CD4060BCJ NS Package Number J16A



Molded Dual-In-Line Package (N) Order Number CD4020BMN, CD4020BCN, CD4040BMN, CD4040BCN, CD4060BMN or CD4060BCN NS Package Number N16E

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