

## CD4029BM/CD4029BC Presettable Binary/Decade Up/Down Counter

### General Description

The CD4029BM/CD4029BC is a presettable up/down counter which counts in either binary or decade mode depending on the voltage level applied at binary/decade input. When binary/decade is at logical "1", the counter counts in binary, otherwise it counts in decade. Similarly, the counter counts up when the up/down input is at logical "1" and vice versa.

A logical "1" preset enable signal allows information at the "jam" inputs to preset the counter to any state asynchronously with the clock. The counter is advanced one count at the positive-going edge of the clock if the carry in and preset enable inputs are at logical "0". Advancement is inhibited when either or both of these two inputs is at logical "1". The carry out signal is normally at logical "1" state and goes to logical "0" state when the counter reaches its maximum

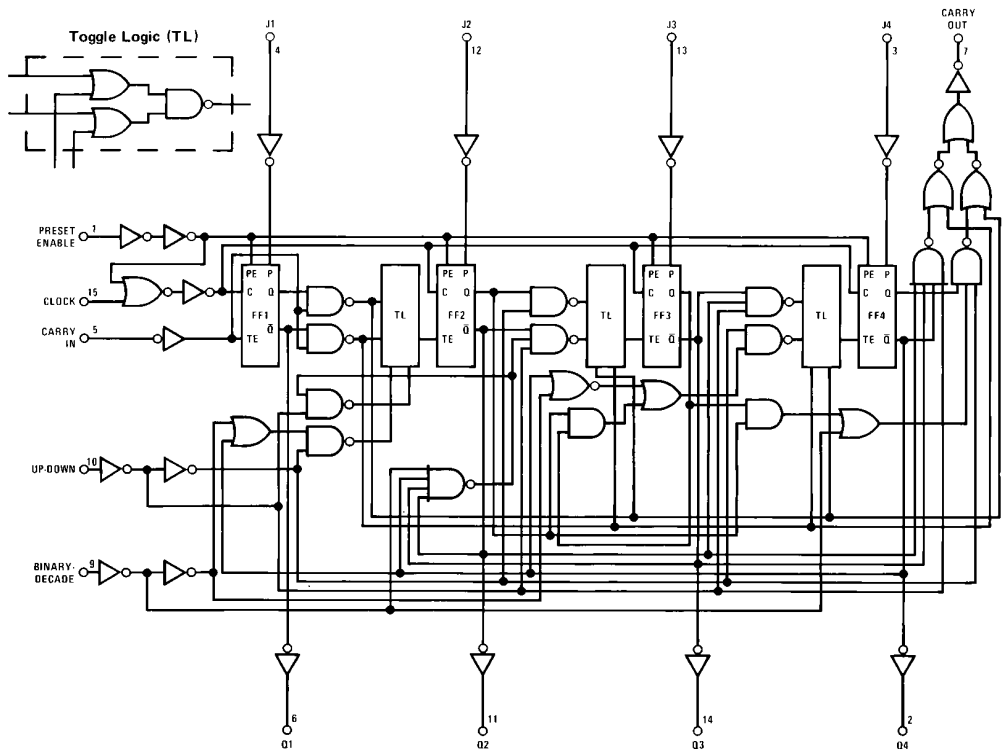
count in the "up" mode or the minimum count in the "down" mode provided the carry input is at logical "0" state.

All inputs are protected against static discharge by diode clamps to both  $V_{DD}$  and  $V_{SS}$ .

### Features

- Wide supply voltage range 3V to 15V
- High noise immunity 0.45  $V_{DD}$  (typ.)
- Low power fan out of 2 driving 74L or 1 driving 74LS
- TTL compatibility
- Parallel jam inputs
- Binary or BCD decade up/down counting

### Logic Diagram



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## 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.

DC Supply Voltage ( $V_{DD}$ )	-0.5V to +18 $V_{DC}$
Input Voltage ( $V_{IN}$ )	-0.5V to $V_{DD}$ + 0.5 $V_{DC}$
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 2)

DC Supply Voltage ( $V_{DD}$ )	3V to 15 $V_{DC}$
Input Voltage ( $V_{IN}$ )	0V to $V_{DD}$ $V_{DC}$
Operating Temperature Range ( $T_A$ )	
CD4029BM	-55°C to +125°C
CD4029BC	-40°C to +85°C

## DC Electrical Characteristics CD4029BM (Note 2)

Symbol	Parameter	Conditions	-55°C		+25°C			+125°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
$I_{DD}$	Quiescent Device Current	$V_{DD} = 5V$		5			5	5	150	$\mu A$
		$V_{DD} = 10V$		10			10		300	$\mu A$
		$V_{DD} = 15V$		20			20		600	$\mu A$
$V_{OL}$	Low Level Output Voltage	$ I_O  < 1 \mu A$								
		$V_{DD} = 5V$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$		0.05		0	0.05		0.05	V
$V_{OH}$	High Level Output Voltage	$ I_O  < 1 \mu A$								
		$V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
$V_{IL}$	Low Level Input Voltage	$V_{DD} = 5V, V_O = 0.5V$ or 4.5V		1.5			1.5		1.5	V
		$V_{DD} = 10V, V_O = 1V$ or 9V		3.0			3.0		3.0	V
		$V_{DD} = 15V, V_O = 1.5V$ or 13.5V		4.0			4.0		4.0	V
$V_{IH}$	High Level Input Voltage	$V_{DD} = 5V, V_O = 0.5V$ or 4.5V	3.5		3.5			3.5		V
		$V_{DD} = 10V, V_O = 1V$ or 9V	7.0		7.0			7.0		V
		$V_{DD} = 15V, V_O = 1.5V$ or 13.5V	11.0		11.0			11.0		V
$I_{OL}$	Low Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 0.4V$	0.64		0.51	0.88		0.36		mA
		$V_{DD} = 10V, V_O = 0.5V$	1.6		1.3	2.25		0.9		mA
		$V_{DD} = 15V, V_O = 1.5V$	4.2		3.4	8.8		2.4		mA
$I_{OH}$	High Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 4.6V$	-0.64		-0.51	-0.88		-0.36		mA
		$V_{DD} = 10V, V_O = 9.5V$	-1.6		-1.3	-2.25		-0.9		mA
		$V_{DD} = 15V, V_O = 13.5V$	-4.2		-3.4	-8.8		-2.4		mA
$I_{IN}$	Input Current	$V_{DD} = 15V, V_{IN} = 0V$		-0.1		$-10^{-5}$	-0.1		-1.0	$\mu A$
		$V_{DD} = 15V, V_{IN} = 15V$		0.1		$10^{-5}$	0.1		1.0	$\mu A$

## DC Electrical Characteristics CD4029BC (Note 2)

Symbol	Parameter	Conditions	-40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
$I_{DD}$	Quiescent Device Current	$V_{DD} = 5V$		20			20		150	$\mu A$
		$V_{DD} = 10V$		40			40		300	$\mu A$
		$V_{DD} = 15V$		80			80		600	$\mu A$
$V_{OL}$	Low Level Output Voltage	$ I_O  < 1 \mu A$								
		$V_{DD} = 5V$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$		0.05		0	0.05		0.05	V
$V_{OH}$	High Level Output Voltage	$ I_O  < 1 \mu A$								
		$V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
$V_{OH}$	High Level Output Voltage	$V_{DD} = 15V$	14.95		14.95	15		14.95		V

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

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

**Note 3:**  $I_{OH}$  and  $I_{OL}$  are tested one output at a time.

## DC Electrical Characteristics CD4029BC (Note 2) (Continued)

Symbol	Parameter	Conditions	-40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
V <sub>IL</sub>	Low Level Input Voltage	V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.5V or 4.5V		1.5			1.5		1.5	V
		V <sub>DD</sub> = 10V, V <sub>O</sub> = 1V or 9V		3.0			3.0		3.0	V
		V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V or 13.5V		4.0			4.0		4.0	V
V <sub>IH</sub>	High Level Input Voltage	V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.5V or 4.5V	3.5		3.5			3.5		V
		V <sub>DD</sub> = 10V, V <sub>O</sub> = 1V or 9V	7.0		7.0			7.0		V
		V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V or 13.5V	11.0		11.0			11.0		V
I <sub>OL</sub>	Low Level Output Current (Note 3)	V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.4V	0.52		0.44	0.88		0.36		mA
		V <sub>DD</sub> = 10V, V <sub>O</sub> = 0.5V	1.3		1.1	2.25		0.9		mA
		V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V	3.6		3.0	8.8		2.4		mA
I <sub>OH</sub>	High Level Output Current (Note 3)	V <sub>DD</sub> = 5V, V <sub>O</sub> = 4.6V	-0.52		-0.44	-0.88		-0.36		mA
		V <sub>DD</sub> = 10V, V <sub>O</sub> = 9.5V	-1.3		-1.1	-2.25		-0.9		mA
		V <sub>DD</sub> = 15V, V <sub>O</sub> = 13.5V	-3.6		-3.0	-8.8		-2.4		mA
I <sub>IN</sub>	Input Current	V <sub>DD</sub> = 15V, V <sub>IN</sub> = 0V V <sub>DD</sub> = 15V, V <sub>IN</sub> = 15V		-0.3 0.3		-10 <sup>-5</sup> 10 <sup>-5</sup>	-0.3 0.3		-1.0 1.0	μA μA

## AC Electrical Characteristics\*

T<sub>A</sub> = 25°C, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 200k, Input t<sub>rCL</sub> = t<sub>fCL</sub> = 20 ns, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units		
<b>CLOCKED OPERATION</b>								
t <sub>PHL</sub> or t <sub>PLH</sub>	Propagation Delay Time to Q Outputs	V <sub>DD</sub> = 5V		200	400	ns		
		V <sub>DD</sub> = 10V		85	170	ns		
		V <sub>DD</sub> = 15V		70	140	ns		
t <sub>PHL</sub> or t <sub>PLH</sub>	Propagation Delay Time to Carry Output	V <sub>DD</sub> = 5V		320	640	ns		
		V <sub>DD</sub> = 10V		135	270	ns		
		V <sub>DD</sub> = 15V		110	220	ns		
t <sub>PHL</sub> or t <sub>PLH</sub>	Propagation Delay Time to Carry Output	C <sub>L</sub> = 15 pF						
		V <sub>DD</sub> = 5V		285	570	ns		
		V <sub>DD</sub> = 10V		120	240	ns		
t <sub>PHL</sub> or t <sub>PLH</sub>	Propagation Delay Time to Carry Output	V <sub>DD</sub> = 15V		95	190	ns		
		V <sub>DD</sub> = 5V		100	200	ns		
		V <sub>DD</sub> = 10V		50	100	ns		
t <sub>THL</sub> or t <sub>TLH</sub>	Transition Time/Q or Carry Output	V <sub>DD</sub> = 15V		40	80	ns		
		V <sub>DD</sub> = 5V		160	320	ns		
		V <sub>DD</sub> = 10V		70	135	ns		
t <sub>WH</sub> or t <sub>WL</sub>	Minimum Clock Pulse Width	V <sub>DD</sub> = 15V		55	110	ns		
		V <sub>DD</sub> = 5V		15		μs		
		V <sub>DD</sub> = 10V		10		μs		
t <sub>rCL</sub> or t <sub>fCL</sub>	Maximum Clock Rise and Fall Time	V <sub>DD</sub> = 15V		5		μs		
		V <sub>DD</sub> = 5V		180	360	ns		
		V <sub>DD</sub> = 10V		70	140	ns		
t <sub>SU</sub>	Minimum Set-Up Time	V <sub>DD</sub> = 15V		55	110	ns		
		V <sub>DD</sub> = 5V		1.5	3.1	MHz		
		V <sub>DD</sub> = 10V		3.7	7.4	MHz		
f <sub>CL</sub>	Maximum Clock Frequency	V <sub>DD</sub> = 15V		4.5	9	MHz		
		C <sub>IN</sub>	Average Input Capacitance	Any Input		5	7.5	pF
		C <sub>PD</sub>	Power Dissipation Capacitance	Per Package (Note 4)		65		pF

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

**Note 2:** V<sub>SS</sub> = 0V unless otherwise specified.

**Note 3:** I<sub>OH</sub> and I<sub>OL</sub> are tested one output at a time.

## AC Electrical Characteristics\*

$T_A = 25^\circ\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}$ , Input  $t_{rCL} = t_{fCL} = 20\text{ ns}$ , unless otherwise specified (Continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>PRESET ENABLE OPERATION</b>						
$t_{PHL}$ or $t_{PLH}$	Propagation Delay Time to Q output	$V_{DD} = 5\text{V}$		285	570	ns
		$V_{DD} = 10\text{V}$		115	230	ns
		$V_{DD} = 15\text{V}$		95	195	ns
$t_{PHL}$ or $t_{PLH}$	Propagation Delay Time to Carry Output	$V_{DD} = 5\text{V}$		400	800	ns
		$V_{DD} = 10\text{V}$		165	330	ns
		$V_{DD} = 15\text{V}$		135	260	ns
$t_{WH}$	Minimum Preset Enable Pulse Width	$V_{DD} = 5\text{V}$		80	160	ns
		$V_{DD} = 10\text{V}$		30	60	ns
		$V_{DD} = 15\text{V}$		25	50	ns
$t_{REM}$	Minimum Preset Enable Removal Time	$V_{DD} = 5\text{V}$		150	300	ns
		$V_{DD} = 10\text{V}$		60	120	ns
		$V_{DD} = 15\text{V}$		50	100	ns
<b>CARRY INPUT OPERATION</b>						
$t_{PHL}$ or $t_{PLH}$	Propagation Delay Time to Carry Output	$V_{DD} = 5\text{V}$		265	530	ns
		$V_{DD} = 10\text{V}$		110	220	ns
		$V_{DD} = 15\text{V}$		90	180	ns
$t_{PHL}$ , $t_{PLH}$	Propagation Delay Time to Carry Output	$C_L = 15\text{ pF}$				
		$V_{DD} = 5\text{V}$		200	400	ns
		$V_{DD} = 10\text{V}$		85	170	ns
		$V_{DD} = 15\text{V}$		70	140	ns

\*AC Parameters are guaranteed by DC correlated testing.

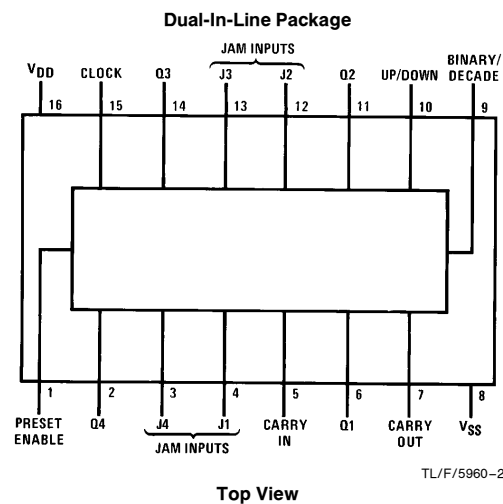
**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

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

**Note 3:**  $I_{OH}$  and  $I_{OL}$  are tested one output at a time.

**Note 4:**  $C_{pD}$  determines the no load AC power consumption of any CMOS device. For complete explanation, see 54C/74C Family Characteristics application note, AN-90.

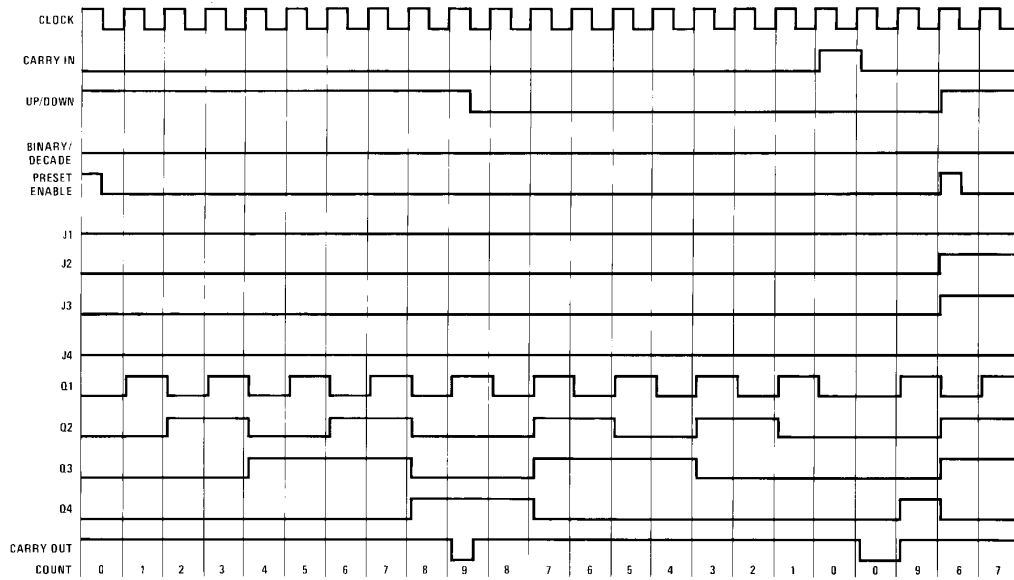
## Connection Diagram



Order Number CD4029B

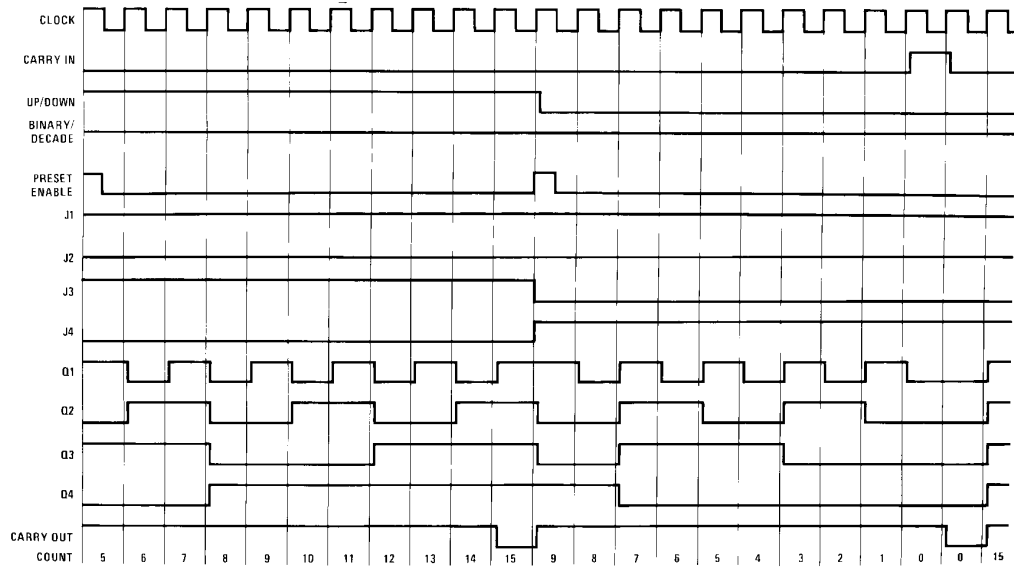
# Logic Waveforms

## Decade Mode



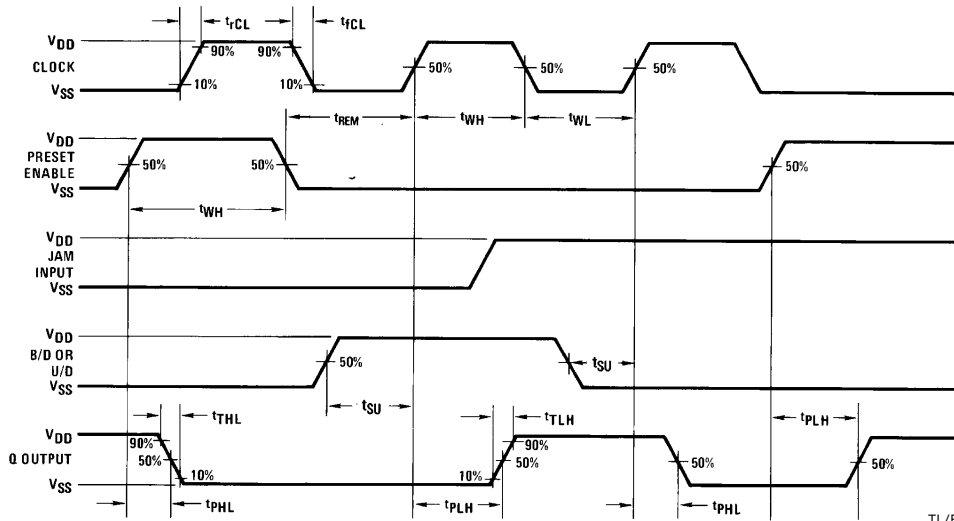
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## Binary Mode



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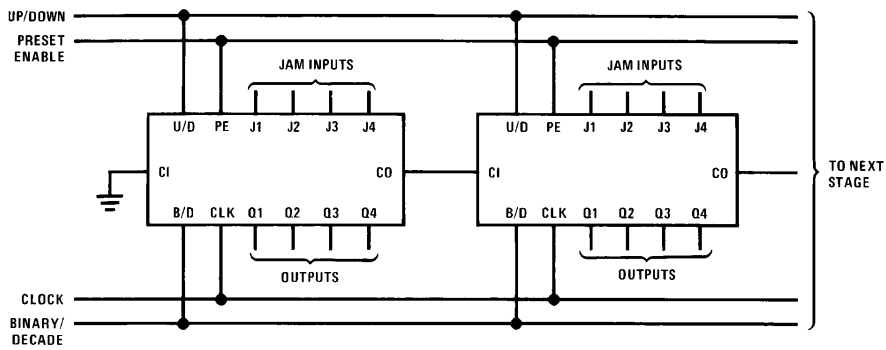
## Switching Time Waveforms



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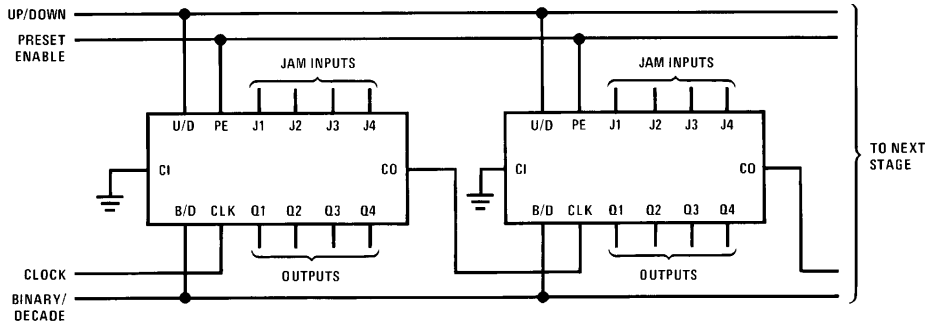
## Cascading Packages

### Parallel Clocking



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### Ripple Clocking

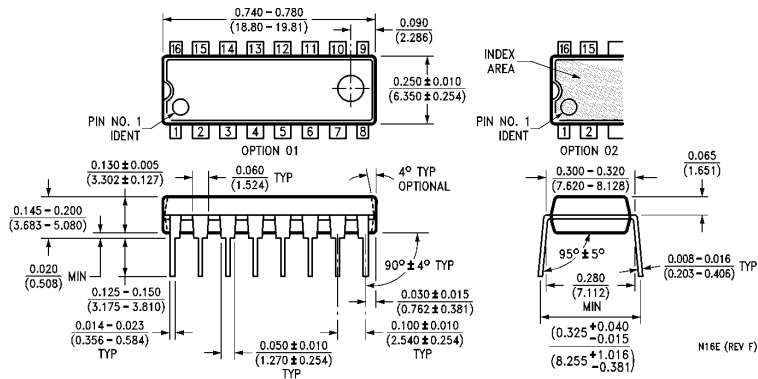
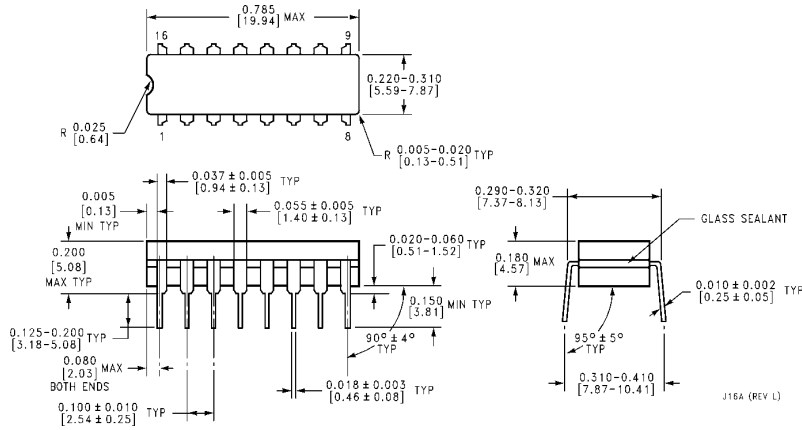


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Carry out lines at the 2nd or later stages may have a negative-going spike due to differential internal delays. These spikes do not affect counter operation, but if the carry out is used to trigger external circuitry the carry out should be gated with the clock.



**Physical Dimensions** inches (millimeters)



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