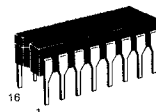
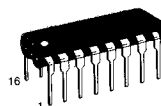


**BINARY/DECADE UP/DOWN COUNTER**

The MC14029B Binary/Decade up/down counter is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. The counter consists of type D flip-flop stages with a gating structure to provide toggle flip-flop capability. The counter can be used in either Binary or BCD operation. This complementary MOS counter finds primary use in up/down and difference counting and frequency synthesizer applications where low power dissipation and/or high noise immunity is desired. It is also useful in A/D and D/A conversion and for magnitude and sign generation.

- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Internally Synchronous for High Speed
- Logic Edge-Clocked Design -- Count Occurs on Positive Going Edge of Clock
- Asynchronous Preset Enable Operation
- Capable of Driving Two Low-power TTL Loads or One Low-power Schottky TTL Load Over the Rated Temperature Range
- Pin for Pin Replacement for CD4029B


**L SUFFIX**  
 CERAMIC  
 CASE 620

**P SUFFIX**  
 PLASTIC  
 CASE 648

**D SUFFIX**  
 SOIC  
 CASE 751B

**ORDERING INFORMATION**

MC14XXXBCP Plastic  
 MC14XXXBCL Ceramic  
 MC14XXXBD SOIC

T<sub>A</sub> = -55° to 125°C for all packages.

**MAXIMUM RATINGS\*** (Voltages Referenced to V<sub>SS</sub>)

Symbol	Parameter	Value	Unit
V <sub>DD</sub>	DC Supply Voltage	-0.5 to +18.0	V
V <sub>in</sub> , V <sub>out</sub>	Input or Output Voltage (DC or Transient)	-0.5 to V <sub>DD</sub> + 0.5	V
I <sub>in</sub> , I <sub>out</sub>	Input or Output Current (DC or Transient), per Pin	±10	mA
P <sub>D</sub>	Power Dissipation, per Package†	500	mW
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
T <sub>L</sub>	Lead Temperature (8-Second Soldering)	260	°C

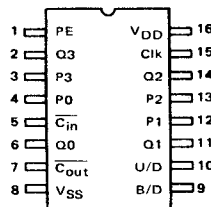
\*Maximum Ratings are those values beyond which damage to the device may occur.

†Temperature Derating: Plastic "P and D/DW" Packages: -7.0 mW/°C From 65°C To 125°C  
 Ceramic "L" Packages: -12 mW/°C From 100°C To 125°C

**TRUTH TABLE**

Carry In	Up/Down	Preset Enable	Action
1	X	0	No Count
0	1	0	Count Up
0	0	0	Count Down
X	X	1	Preset

X = Don't Care

**PIN ASSIGNMENT**


# MC14029B

## ELECTRICAL CHARACTERISTICS (Voltages Referenced to $V_{SS}$ )

Characteristic	Symbol	$V_{DD}$ Vdc	-55°C		25°C			125°C		Unit	
			Min	Max	Min	Typ #	Max	Min	Max		
Output Voltage $V_{in} = V_{DD}$ or 0	"0" Level $V_{OL}$	5.0	—	0.05	—	0	0.05	—	0.05	Vdc	
		10	—	0.05	—	0	0.05	—	0.05		
		15	—	0.05	—	0	0.05	—	0.05		
	"1" Level $V_{in} = 0$ or $V_{DD}$	$V_{OH}$	5.0	4.95	—	4.95	5.0	—	4.95	—	Vdc
			10	9.95	—	9.95	10	—	9.95	—	
			15	14.95	—	14.95	15	—	14.95	—	
Input Voltage ( $V_O = 4.5$ or $0.5$ Vdc) ( $V_O = 9.0$ or $1.0$ Vdc) ( $V_O = 13.5$ or $1.5$ Vdc)	"0" Level $V_{IL}$	5.0	—	1.5	—	2.25	1.5	—	1.5	Vdc	
		10	—	3.0	—	4.50	3.0	—	3.0		
		15	—	4.0	—	6.75	4.0	—	4.0		
	"1" Level ( $V_O = 0.5$ or $4.5$ Vdc) ( $V_O = 1.0$ or $9.0$ Vdc) ( $V_O = 1.5$ or $13.5$ Vdc)	$V_{IH}$	5.0	3.5	—	3.5	2.75	—	3.5	—	Vdc
			10	7.0	—	7.0	5.50	—	7.0	—	
			15	11	—	11	8.25	—	11	—	
Output Drive Current ( $V_{OH} = 2.5$ Vdc) ( $V_{OH} = 4.6$ Vdc) ( $V_{OH} = 9.5$ Vdc) ( $V_{OH} = 13.5$ Vdc)	Source $I_{OH}$	5.0	-3.0	—	-2.4	-4.2	—	-1.7	—	mAdc	
		5.0	-0.64	—	-0.51	-0.88	—	-0.36	—		
		10	-1.6	—	-1.3	-2.25	—	-0.9	—		
	Sink ( $V_{OL} = 0.4$ Vdc) ( $V_{OL} = 0.5$ Vdc) ( $V_{OL} = 1.5$ Vdc)	$I_{OL}$	5.0	0.64	—	0.51	0.88	—	0.36	—	mAdc
			10	1.6	—	1.3	2.25	—	0.9	—	
			15	4.2	—	3.4	8.8	—	2.4	—	
Input Current	$I_{in}$	15	—	±0.1	—	±0.00001	±0.1	—	±1.0	μAdc	
Input Capacitance ( $V_{in} = 0$ )	$C_{in}$	—	—	—	—	5.0	7.5	—	—	pF	
Quiescent Current (Per Package)	$I_{DD}$	5.0	—	5.0	—	0.005	5.0	—	150	μAdc	
		10	—	10	—	0.010	10	—	300		
		15	—	20	—	0.015	20	—	600		
Total Supply Current**† (Dynamic plus Quiescent, Per Package) ( $C_L = 50$ pF on all outputs, all buffers switching)	$I_T$	5.0	$I_T = (0.58 \mu A/kHz) f + I_{DD}$						μAdc		
		10	$I_T = (1.20 \mu A/kHz) f + I_{DD}$								
		15	$I_T = (1.70 \mu A/kHz) f + I_{DD}$								

#Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

\*\*The formulas given are for the typical characteristics only at 25°C.

†To calculate total supply current at loads other than 50 pF:

$$I_T(C_L) = I_T(50 \text{ pF}) + (C_L - 50) \text{ V/k}$$

where:  $I_T$  is in  $\mu A$  (per package),  $C_L$  in pF,  $V = (V_{DD} - V_{SS})$  in volts,  $f$  in kHz is input frequency, and  $k = 0.001$ .

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{in}$  and  $V_{out}$  should be constrained to the range  $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ . Unused inputs must always be tied to an appropriate logic voltage level (e.g., either  $V_{SS}$  or  $V_{DD}$ ). Unused outputs must be left open.

# MC14029B

## SWITCHING CHARACTERISTICS\* ( $C_L = 50 \text{ pF}$ , $T_A = 25^\circ\text{C}$ )

Characteristic	Symbol	$V_{DD}$	All Types			Unit
			Min	Typ #	Max	
<b>Output Rise and Fall Time</b> $t_{TLH}, t_{THL} = (1.5 \text{ ns/pF}) C_L + 25 \text{ ns}$ $t_{TLH}, t_{THL} = (0.75 \text{ ns/pF}) C_L + 12.5 \text{ ns}$ $t_{TLH}, t_{THL} = (0.55 \text{ ns/pF}) C_L + 9.5 \text{ ns}$	$t_{TLH}$ $t_{THL}$	5.0 10 15	— — —	100 50 40	200 100 80	ns
<b>Propagation Delay Time</b> Clk to Q $t_{PLH}, t_{PHL} = (1.7 \text{ ns/pF}) C_L + 230 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.66 \text{ ns/pF}) C_L + 97 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.5 \text{ ns/pF}) C_L + 75 \text{ ns}$ Clk to $C_{out}$ $t_{PLH}, t_{PHL} = (1.7 \text{ ns/pF}) C_L + 230 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.66 \text{ ns/pF}) C_L + 97 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.5 \text{ ns/pF}) C_L + 75 \text{ ns}$ $C_{in}$ to $C_{out}$ $t_{PLH}, t_{PHL} = (1.7 \text{ ns/pF}) C_L + 95 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.66 \text{ ns/pF}) C_L + 47 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.5 \text{ ns/pF}) C_L + 35 \text{ ns}$ PE to Q $t_{PLH}, t_{PHL} = (1.7 \text{ ns/pF}) C_L + 230 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.66 \text{ ns/pF}) C_L + 97 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.5 \text{ ns/pF}) C_L + 75 \text{ ns}$ PE to $C_{out}$ $t_{PLH}, t_{PHL} = (1.7 \text{ ns/pF}) C_L + 465 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.66 \text{ ns/pF}) C_L + 192 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.5 \text{ ns/pF}) C_L + 125 \text{ ns}$	$t_{PLH}$ $t_{PHL}$	5.0 10 15	— — —	200 100 90	400 200 180	ns
	$t_{PLH}$ $t_{PHL}$	5.0 10 15	— — —	250 130 85	500 260 190	ns
	$t_{PLH}$ $t_{PHL}$	5.0 10 15	— — —	175 90 50	360 120 100	ns
	$t_{PLH}$ $t_{PHL}$	5.0 10 15	— — —	235 100 80	470 200 160	ns
	$t_{PLH}$ $t_{PHL}$	5.0 10 15	— — —	320 145 105	640 290 210	ns
Clock Pulse Width	$t_{W(c)}$	5.0 10 15	180 80 60	90 40 30	— — —	ns
Clock Pulse Frequency	$f_{cl}$	5.0 10 15	— — —	4.0 8.0 10	2.0 4.0 5.0	MHz
Preset Removal Time The Preset Signal must be low prior to a positive-going transition of the clock.	$t_{rem}$	5.0 10 15	160 80 60	80 40 30	— — —	ns
Clock Rise and Fall Time	$t_{r(c)}$ $t_{f(c)}$	5.0 10 15	— — —	— — —	15 5 4	$\mu\text{s}$
Carry In Setup Time	$t_{su}$	5.0 10 15	150 60 40	75 30 20	— — —	ns
Up/Down Setup Time		5.0 10 15	340 140 100	170 70 50	— — —	ns
Binary/Decade Setup Time		5.0 10 15	320 140 100	160 70 50	— — —	ns
Preset Enable Pulse Width	$t_W$	5.0 10 15	130 70 50	65 35 25	— — —	ns

\*The formulas given are for the typical characteristics only at 25°C.

#Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

# MC14029B

FIGURE 1 – POWER DISSIPATION TEST CIRCUIT AND WAVEFORM

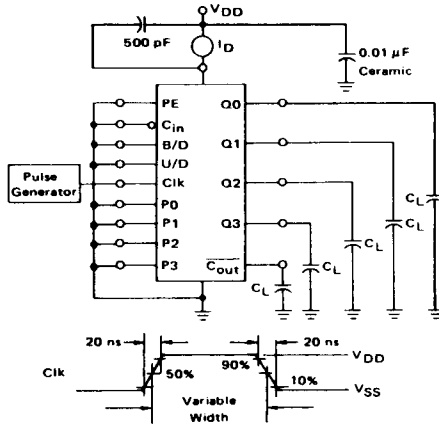
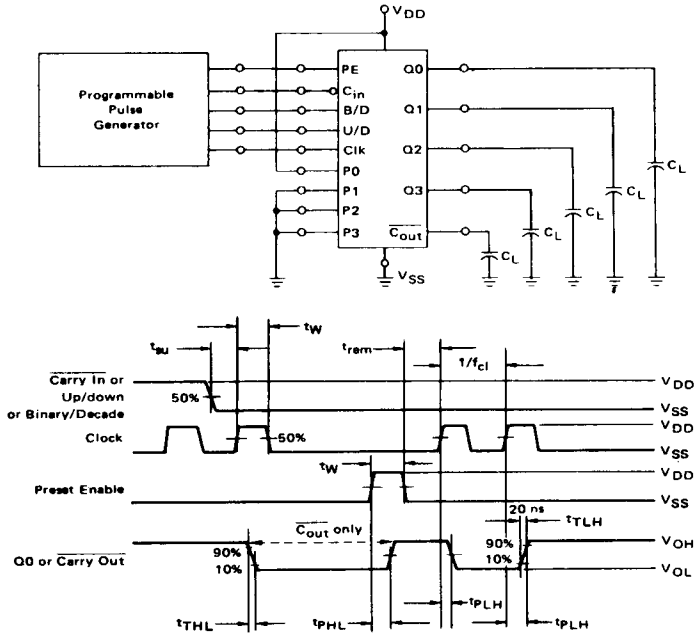


FIGURE 2 – SWITCHING TIME TEST CIRCUIT AND WAVEFORMS



# MC14029B

## TIMING DIAGRAM

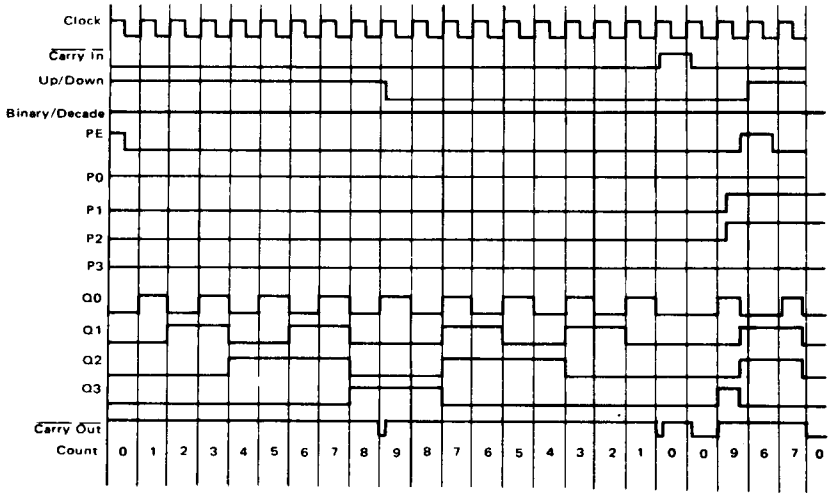
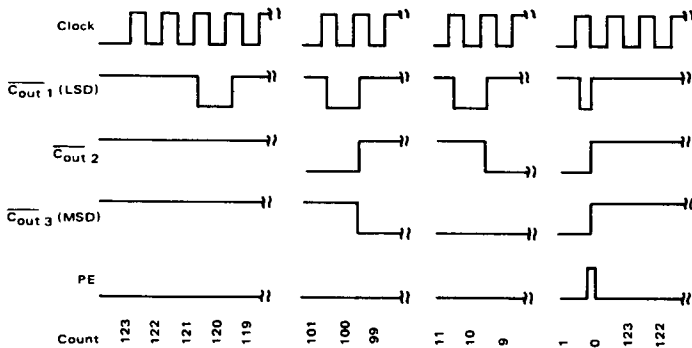
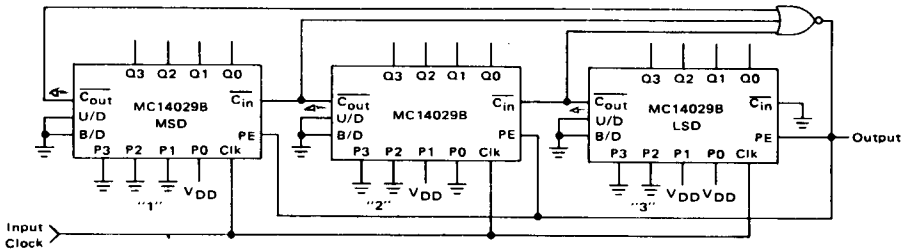
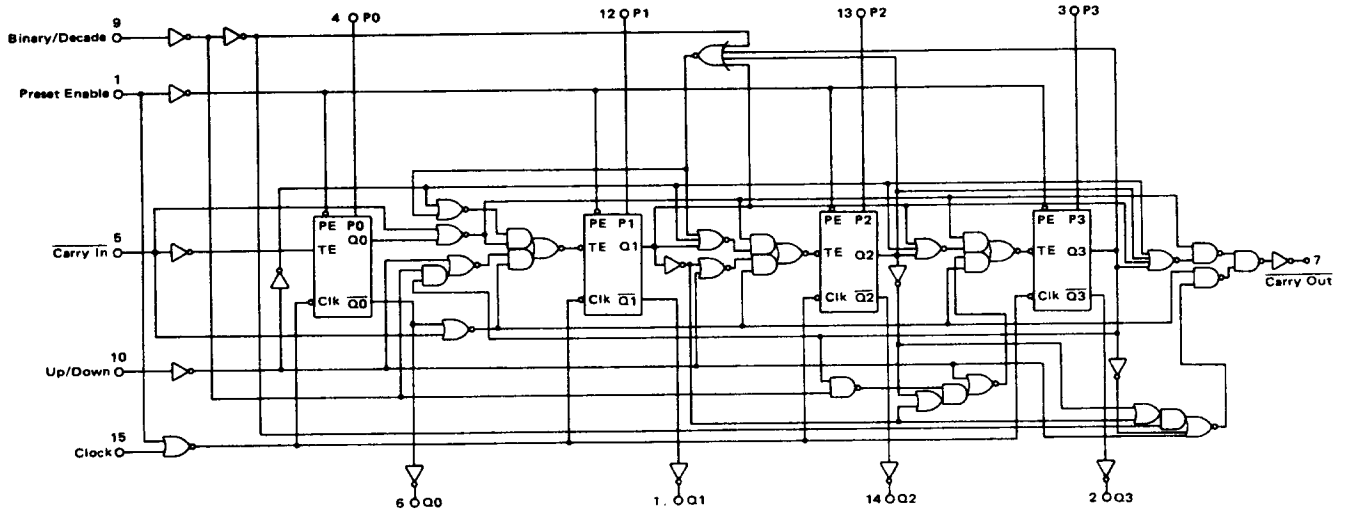


FIGURE 3 – DIVIDE BY N BCD DOWN COUNTER and TIMING DIAGRAM  
(Shown for N = 123)



\*  $t_w \approx 900 \text{ ns} @ V_{DD} = 5 \text{ V}$

LOGIC DIAGRAM



MC14029B