

## 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

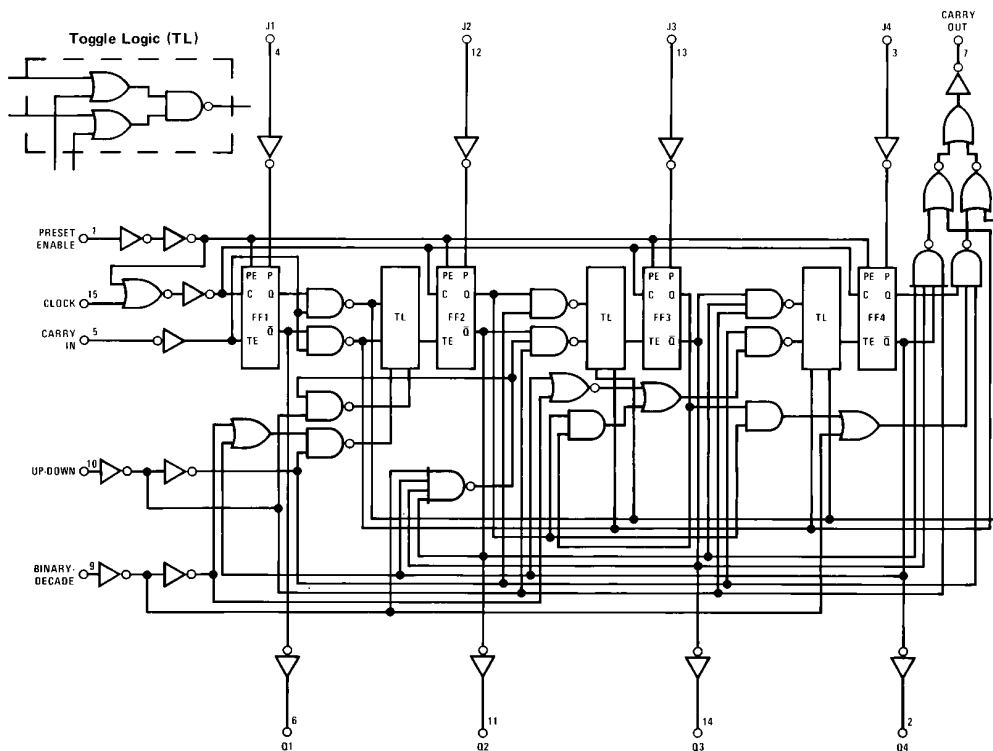
count in the "up" mode or the minimum count in the "down" mode provided the carry input is at logical "0" state.

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



TL/F/5960-1

## 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       |
|          |                                    | $V_{DD} = 15V$                      |       | 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       |
|          |                                    | $V_{DD} = 15V$                      | 14.95 |      | 14.95 | 15         |      | 14.95  |      | 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      |
|          |                                    |                                     |       |      |       |            |      |        |      | 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       |
|          |                           | $V_{DD} = 15V$    |       | 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       |
|          |                           | $V_{DD} = 15V$    | 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<br>V <sub>DD</sub> = 10V, V <sub>O</sub> = 1V or 9V<br>V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V or 13.5V |                       | 1.5<br>3.0<br>4.0 |                       |                                       | 1.5<br>3.0<br>4.0 |                       | 1.5<br>3.0<br>4.0 | V<br>V<br>V    |
| V <sub>IH</sub> | High Level Input Voltage           | V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.5V or 4.5V<br>V <sub>DD</sub> = 10V, V <sub>O</sub> = 1V or 9V<br>V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V or 13.5V | 3.5<br>7.0<br>11.0    |                   | 3.5<br>7.0<br>11.0    |                                       |                   | 3.5<br>7.0<br>11.0    |                   | V<br>V<br>V    |
| I <sub>OL</sub> | Low Level Output Current (Note 3)  | V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.4V<br>V <sub>DD</sub> = 10V, V <sub>O</sub> = 0.5V<br>V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V                      | 0.52<br>1.3<br>3.6    |                   | 0.44<br>1.1<br>3.0    | 0.88<br>2.25<br>8.8                   |                   | 0.36<br>0.9<br>2.4    |                   | mA<br>mA<br>mA |
| I <sub>OH</sub> | High Level Output Current (Note 3) | V <sub>DD</sub> = 5V, V <sub>O</sub> = 4.6V<br>V <sub>DD</sub> = 10V, V <sub>O</sub> = 9.5V<br>V <sub>DD</sub> = 15V, V <sub>O</sub> = 13.5V                     | −0.52<br>−1.3<br>−3.6 |                   | −0.44<br>−1.1<br>−3.0 | −0.88<br>−2.25<br>−8.8                |                   | −0.36<br>−0.9<br>−2.4 |                   | mA<br>mA<br>mA |
| I <sub>IN</sub> | Input Current                      | V <sub>DD</sub> = 15V, V <sub>IN</sub> = 0V<br>V <sub>DD</sub> = 15V, V <sub>IN</sub> = 15V                                                                      |                       | −0.3<br>0.3       |                       | −10 <sup>−5</sup><br>10 <sup>−5</sup> | −0.3<br>0.3       |                       | −1.0<br>1.0       | μA<br>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<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V                           |                   | 200<br>85<br>70   | 400<br>170<br>140 | ns<br>ns<br>ns    |
| t <sub>PHL</sub> or t <sub>PLH</sub> | Propagation Delay Time to Carry Output | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V                           |                   | 320<br>135<br>110 | 640<br>270<br>220 | ns<br>ns<br>ns    |
| t <sub>PHL</sub> or t <sub>PLH</sub> | Propagation Delay Time to Carry Output | C <sub>L</sub> = 15 pF<br>V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V |                   | 285<br>120<br>95  | 570<br>240<br>190 | ns<br>ns<br>ns    |
| t <sub>THL</sub> or t <sub>TLH</sub> | Transition Time/Q or Carry Output      | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V                           |                   | 100<br>50<br>40   | 200<br>100<br>80  | ns<br>ns<br>ns    |
| t <sub>WH</sub> or t <sub>WL</sub>   | Minimum Clock Pulse Width              | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V                           |                   | 160<br>70<br>55   | 320<br>135<br>110 | ns<br>ns<br>ns    |
| t <sub>rCL</sub> or t <sub>fCL</sub> | Maximum Clock Rise and Fall Time       | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V                           | 15<br>10<br>5     |                   |                   | μs<br>μs<br>μs    |
| t <sub>SU</sub>                      | Minimum Set-Up Time                    | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V                           |                   | 180<br>70<br>55   | 360<br>140<br>110 | ns<br>ns<br>ns    |
| f <sub>CL</sub>                      | Maximum Clock Frequency                | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V                           | 1.5<br>3.7<br>4.5 | 3.1<br>7.4<br>9   |                   | MHz<br>MHz<br>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  $t_{r_{CL}} = t_{f_{CL}} = 20\text{ ns}$ , 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     | $V_{DD} = 5\text{V}$<br>$V_{DD} = 10\text{V}$<br>$V_{DD} = 15\text{V}$                         |     | 285<br>115<br>95  | 570<br>230<br>195 | ns    |
| $t_{PHL}$ or $t_{PLH}$         | Propagation Delay Time to Carry Output | $V_{DD} = 5\text{V}$<br>$V_{DD} = 10\text{V}$<br>$V_{DD} = 15\text{V}$                         |     | 400<br>165<br>135 | 800<br>330<br>260 | ns    |
| $t_{WH}$                       | Minimum Preset Enable Pulse Width      | $V_{DD} = 5\text{V}$<br>$V_{DD} = 10\text{V}$<br>$V_{DD} = 15\text{V}$                         |     | 80<br>30<br>25    | 160<br>60<br>50   | ns    |
| $t_{REM}$                      | Minimum Preset Enable Removal Time     | $V_{DD} = 5\text{V}$<br>$V_{DD} = 10\text{V}$<br>$V_{DD} = 15\text{V}$                         |     | 150<br>60<br>50   | 300<br>120<br>100 | ns    |
| <b>CARRY INPUT OPERATION</b>   |                                        |                                                                                                |     |                   |                   |       |
| $t_{PHL}$ or $t_{PLH}$         | Propagation Delay Time to Carry Output | $V_{DD} = 5\text{V}$<br>$V_{DD} = 10\text{V}$<br>$V_{DD} = 15\text{V}$                         |     | 265<br>110<br>90  | 530<br>220<br>180 | ns    |
| $t_{PHL}$ , $t_{PLH}$          | Propagation Delay Time to Carry Output | $C_L = 15\text{ pF}$<br>$V_{DD} = 5\text{V}$<br>$V_{DD} = 10\text{V}$<br>$V_{DD} = 15\text{V}$ |     | 200<br>85<br>70   | 400<br>170<br>140 | ns    |

\*AC Parameters are guaranteed by DC correlated testing.

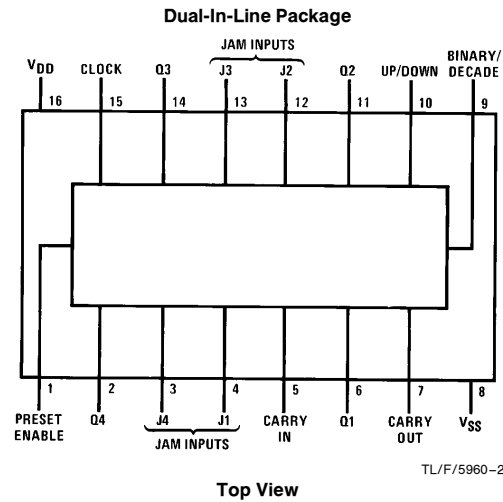
**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for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

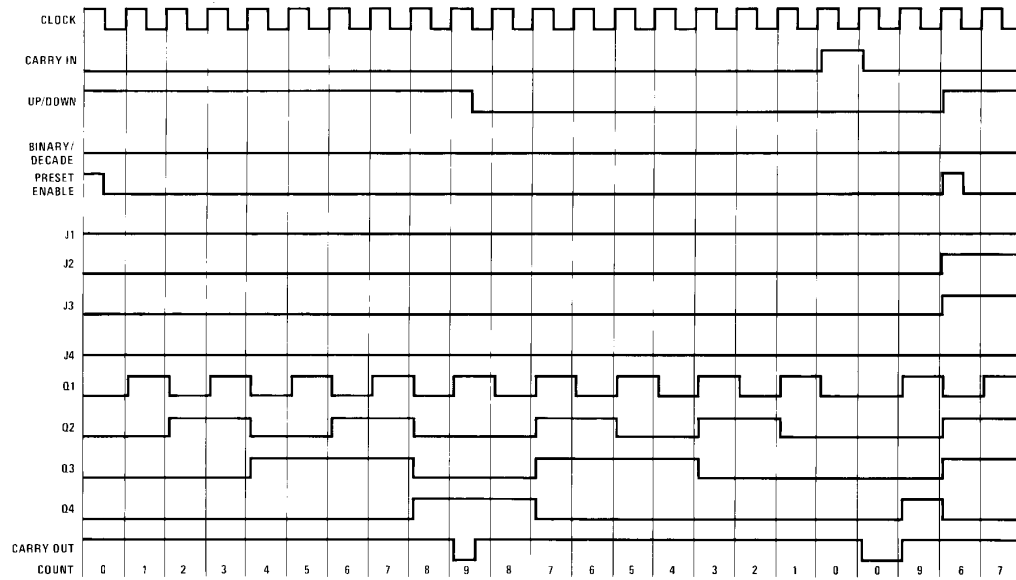
## Connection Diagram



Order Number CD4029B

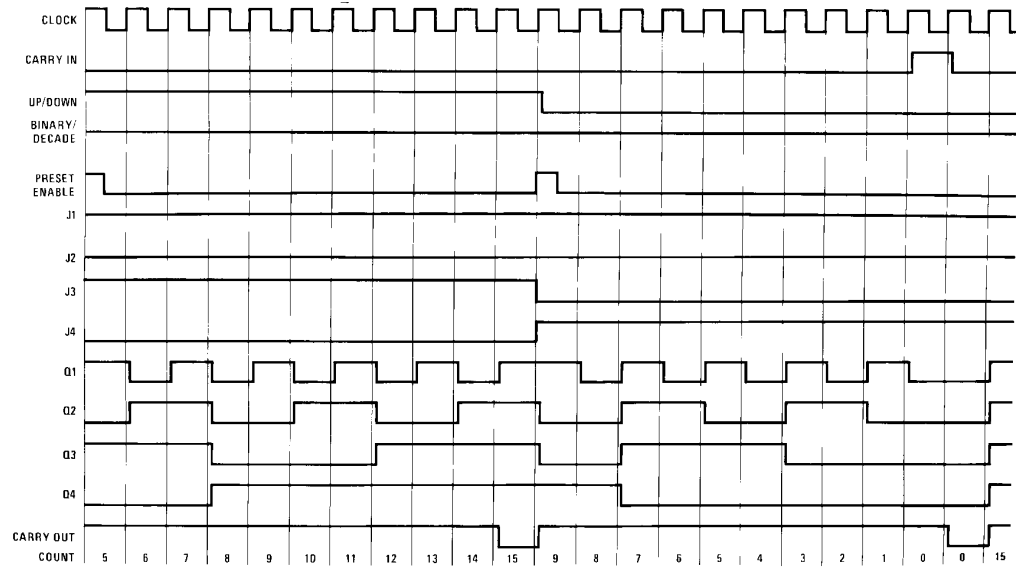
# Logic Waveforms

## Decade Mode



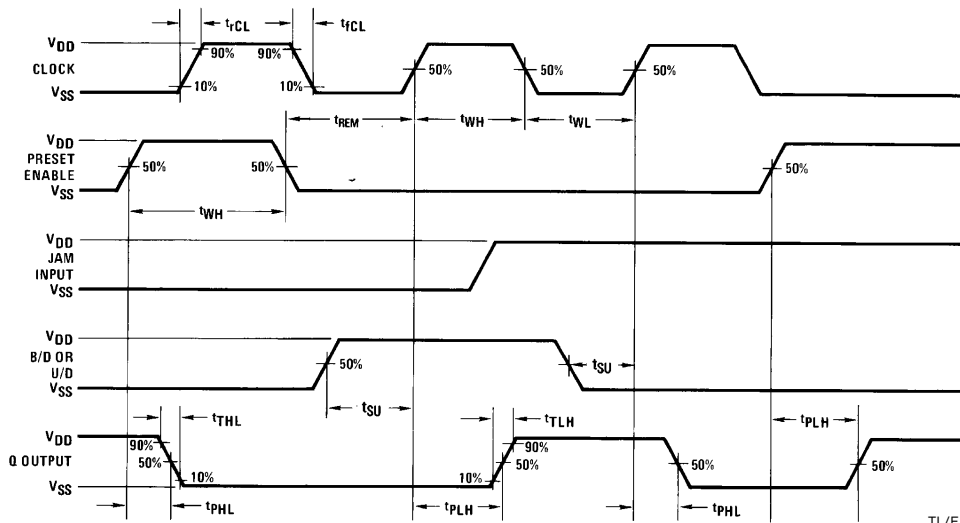
TL/F/5960-3

## Binary Mode



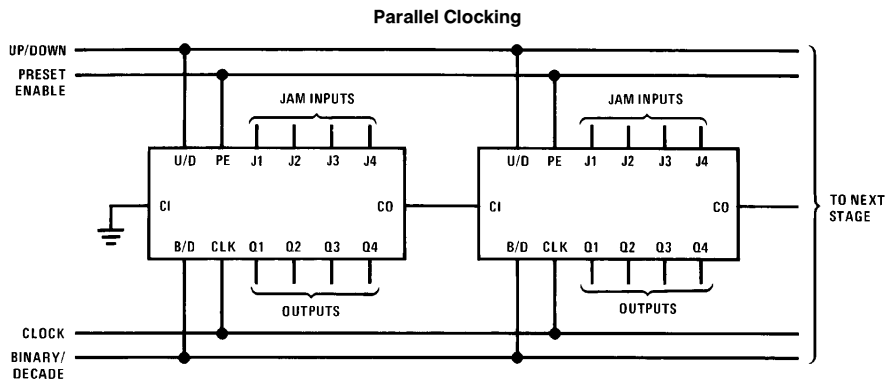
TL/F/5960-4

## Switching Time Waveforms

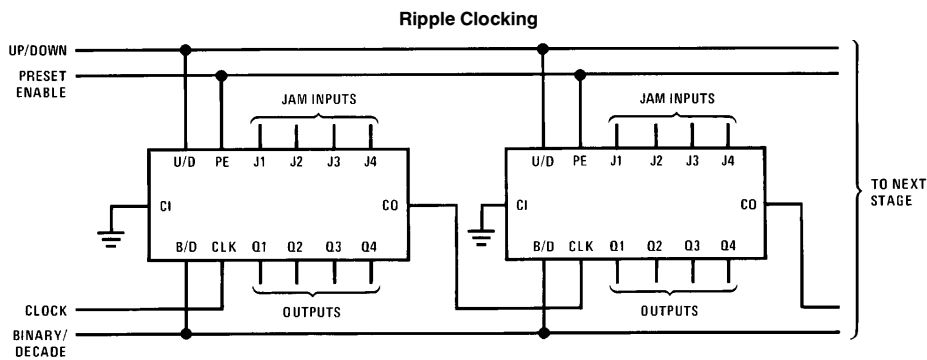


TL/F/5960-5

## Cascading Packages



TL/F/5960-6

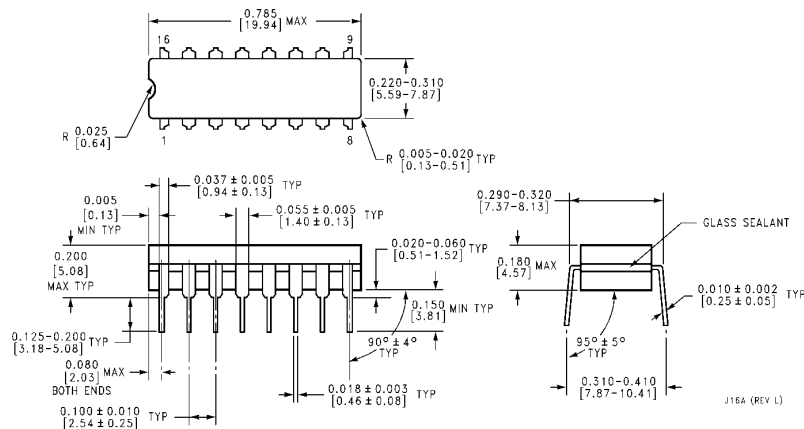


TL/F/5960-7

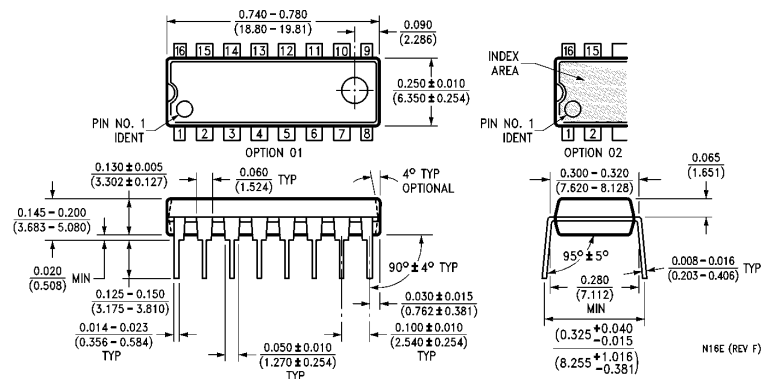
Carry out lines at the 2nd or later stages may have a negative-going spike due to differential internal delays. These spikes do not affect counter operation, but if the carry out is used to trigger external circuitry the carry out should be gated with the clock.



## Physical Dimensions inches (millimeters)



Order Number CD4029BMJ or CD4029BCJ  
NS Package Number J16A



Order Number CD4029BMN or CD4029BCN  
NS Package Number N16E

## LIFE SUPPORT POLICY

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