

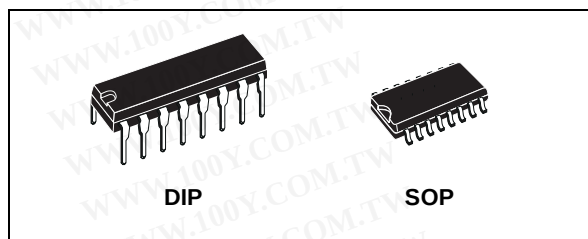


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## HCF4520B

### DUAL BINARY UP COUNTER

- MEDIUM SPEED OPERATION :  
6MHz (Typ.) at 10V
- POSITIVE -OR NEGATIVE- EDGE TRIGGERING
- SYNCHRONOUS INTERNAL CARRY PROPAGATION
- QUIESCENT CURRENT SPECIF. UP TO 20V
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT LEAKAGE CURRENT  
 $I_l = 100\text{nA}$  (MAX) AT  $V_{DD} = 18\text{V}$   $T_A = 25^\circ\text{C}$
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B "STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"



#### ORDER CODES

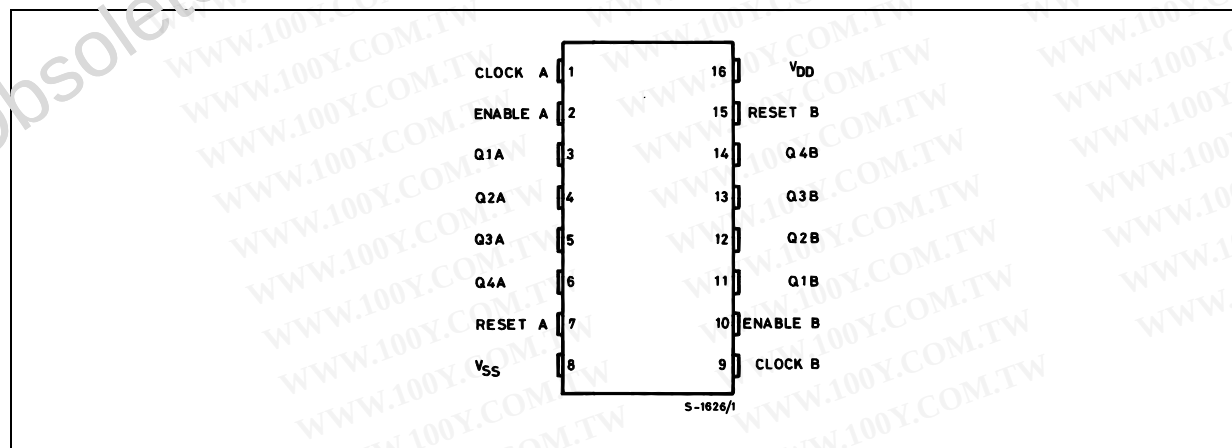
| PACKAGE | TUBE       | 1 & R         |
|---------|------------|---------------|
| DIP     | HCF4520BEY |               |
| SOP     | HCF4520BM1 | HCF4520M013TR |

#### DESCRIPTION

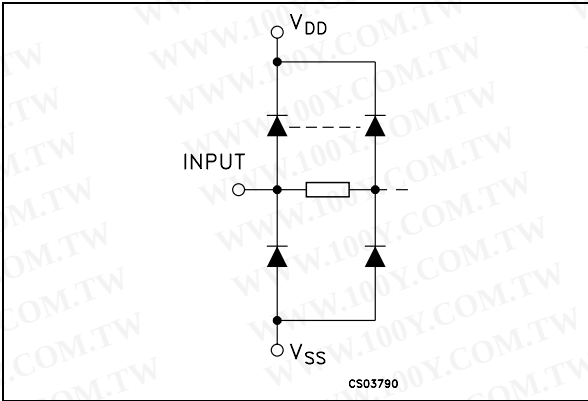
HCF4520B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages. HCF4520B, a Dual Binary Up Counter, consists of two identical, internal 4-stage counters. The counter stages are D-type Flip-Flops having interchangeable Clock and Enable lines for

incrementing on either the positive-going or negative going transitions. For single-unit operations the Enable input is maintained High and the counter advances on each positive going transition of the Clock. The counters are cleared by high levels on their Reset lines. The counter can be cascaded in the ripple mode by connecting Q4 to the enable input of the subsequent counter while the clock input of the latter is held low.

#### PIN CONNECTION



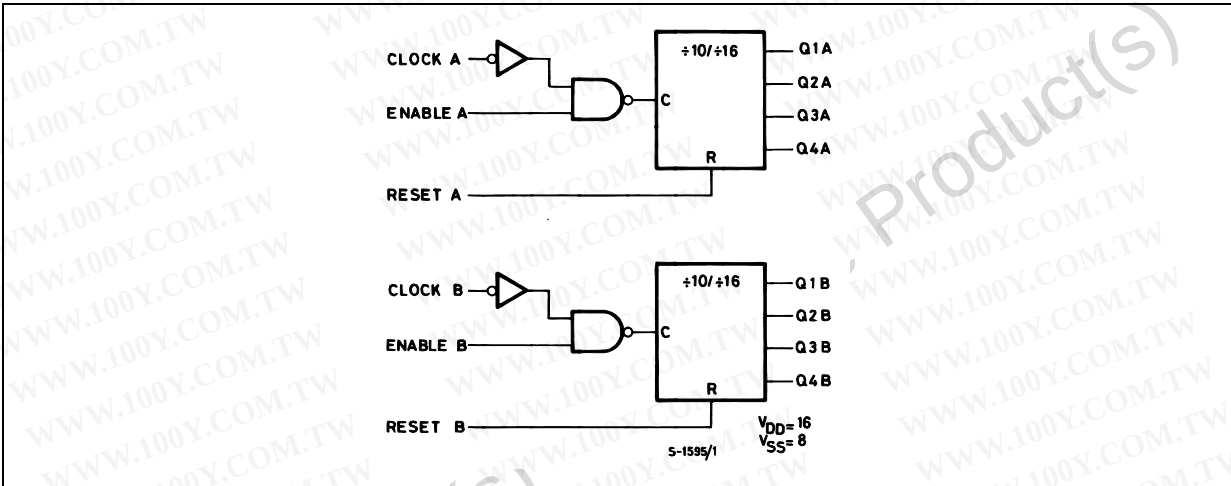
IINPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

| PIN No      | SYMBOL          | NAME AND FUNCTION       |
|-------------|-----------------|-------------------------|
| 1           | CLOCK A         | Clock A input           |
| 2           | ENABLE A        | Enable A Input          |
| 7           | RESET A         | Reset A Input           |
| 3, 4, 5, 6  | Q1A to Q4A      | Data Outputs            |
| 9           | CLOCK B         | Clock B input           |
| 10          | ENABLE B        | Enable B Input          |
| 15          | RESET B         | Reset B Input           |
| 11,12,13,14 | Q1B to Q4B      | Data Outputs            |
| 8           | V <sub>SS</sub> | Negative Supply Voltage |
| 16          | V <sub>DD</sub> | Positive Supply Voltage |

FUNCTIONAL DIAGRAM



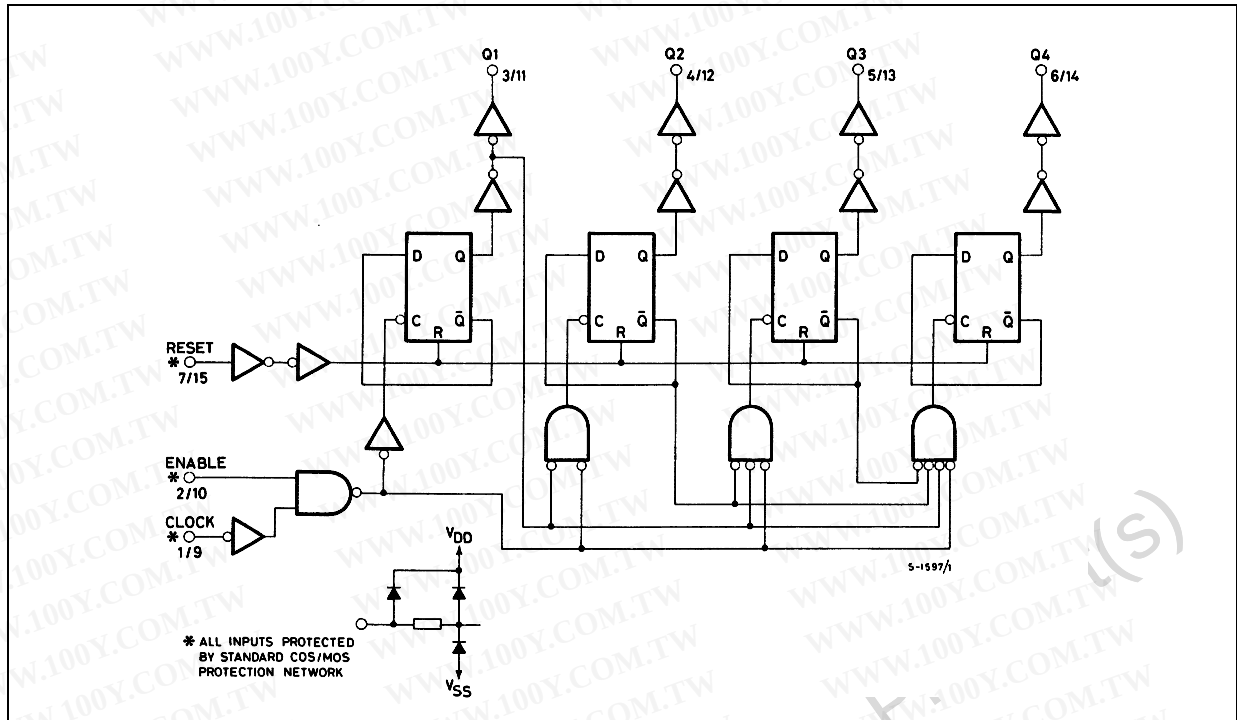
TRUTH TABLE

| CLOCK | ENABLE | RESET | ACTION            |
|-------|--------|-------|-------------------|
|       | H      | L     | INCREMENT COUNTER |
| L     |        | L     | INCREMENT COUNTER |
|       | X      | L     | NO CHANGE         |
| X     |        | L     | NO CHANGE         |
|       | L      | L     | NO CHANGE         |
| H     |        | L     | NO CHANGE         |
| X     | X      | H     | Q1 THRU Q4 = 0    |

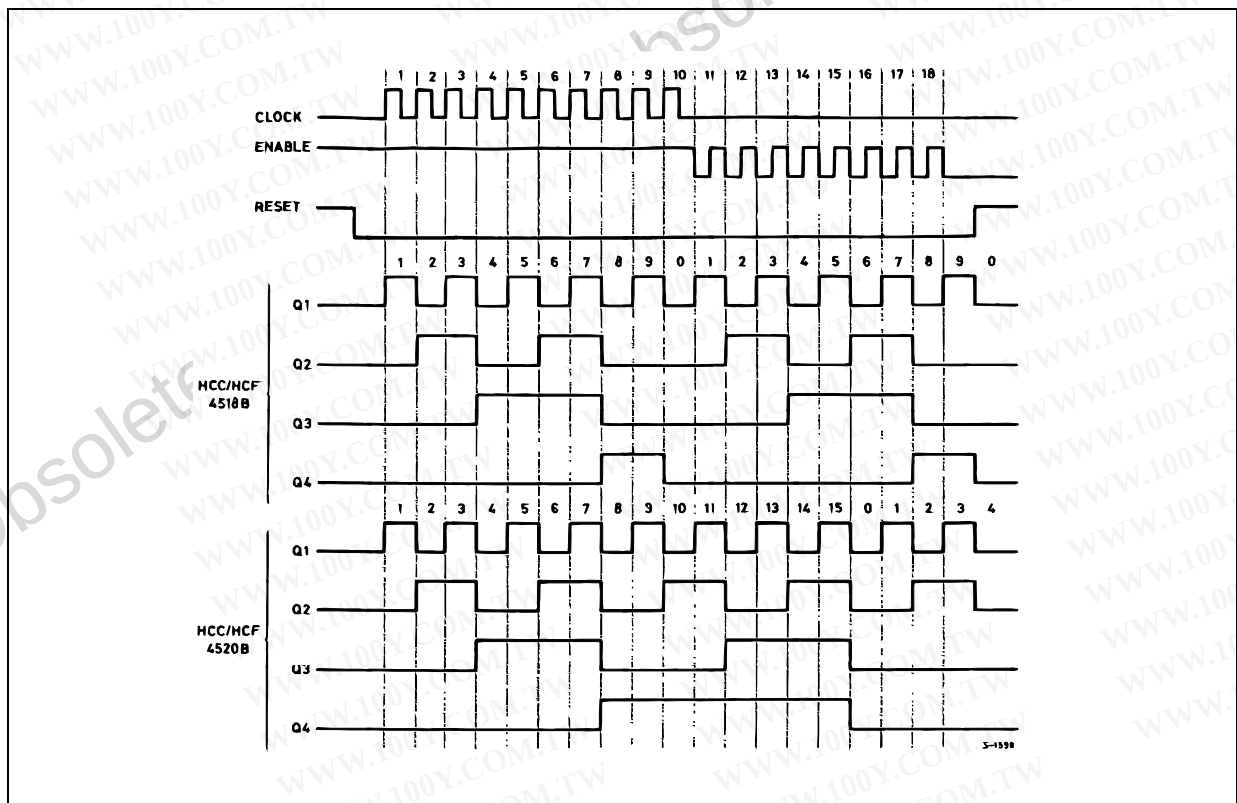
X : Don't Care



## LOGIC DIAGRAM



## TIMING CHART



## ABSOLUTE MAXIMUM RATINGS

| Symbol    | Parameter                               | Value                  | Unit |
|-----------|-----------------------------------------|------------------------|------|
| $V_{DD}$  | Supply Voltage                          | -0.5 to +22            | V    |
| $V_I$     | DC Input Voltage                        | -0.5 to $V_{DD} + 0.5$ | V    |
| $I_I$     | DC Input Current                        | $\pm 10$               | mA   |
| $P_D$     | Power Dissipation per Package           | 200                    | mW   |
|           | Power Dissipation per Output Transistor | 100                    | mW   |
| $T_{op}$  | Operating Temperature                   | -55 to +125            | °C   |
| $T_{stg}$ | Storage Temperature                     | -65 to +150            | °C   |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

All voltage values are referred to  $V_{SS}$  pin voltage.

## RECOMMENDED OPERATING CONDITIONS

| Symbol   | Parameter             | Value         | Unit |
|----------|-----------------------|---------------|------|
| $V_{DD}$ | Supply Voltage        | 3 to 20       | V    |
| $V_I$    | Input Voltage         | 0 to $V_{DD}$ | V    |
| $T_{op}$ | Operating Temperature | -55 to 125    | °C   |

## DC SPECIFICATIONS

| Symbol          | Parameter                 | Test Condition        |                       |                           |                        | Value                 |                   |      |             |      |              |      | Unit |
|-----------------|---------------------------|-----------------------|-----------------------|---------------------------|------------------------|-----------------------|-------------------|------|-------------|------|--------------|------|------|
|                 |                           | V <sub>I</sub><br>(V) | V <sub>O</sub><br>(V) | I <sub>OL</sub>  <br>(μA) | V <sub>DD</sub><br>(V) | T <sub>A</sub> = 25°C |                   |      | -40 to 85°C |      | -55 to 125°C |      |      |
|                 |                           |                       |                       |                           |                        | Min.                  | Typ.              | Max. | Min.        | Max. | Min.         | Max. |      |
| I <sub>L</sub>  | Quiescent Current         | 0/5                   |                       |                           | 5                      |                       | 0.04              | 5    |             | 150  |              | 150  | μA   |
|                 |                           | 0/10                  |                       |                           | 10                     |                       | 0.04              | 10   |             | 300  |              | 300  |      |
|                 |                           | 0/15                  |                       |                           | 15                     |                       | 0.04              | 20   |             | 600  |              | 600  |      |
|                 |                           | 0/20                  |                       |                           | 20                     |                       | 0.08              | 100  |             | 3000 |              | 3000 |      |
| V <sub>OH</sub> | High Level Output Voltage | 0/5                   |                       | <1                        | 5                      | 4.95                  |                   |      | 4.95        |      | 4.95         |      | V    |
|                 |                           | 0/10                  |                       | <1                        | 10                     | 9.95                  |                   |      | 9.95        |      | 9.95         |      |      |
|                 |                           | 0/15                  |                       | <1                        | 15                     | 14.95                 |                   |      | 14.95       |      | 14.95        |      |      |
| V <sub>OL</sub> | Low Level Output Voltage  | 5/0                   |                       | <1                        | 5                      |                       | 0.05              |      |             | 0.05 |              | 0.05 | V    |
|                 |                           | 10/0                  |                       | <1                        | 10                     |                       | 0.05              |      |             | 0.05 |              | 0.05 |      |
|                 |                           | 15/0                  |                       | <1                        | 15                     |                       | 0.05              |      |             | 0.05 |              | 0.05 |      |
| V <sub>IH</sub> | High Level Input Voltage  |                       | 0.5/4.5               | <1                        | 5                      | 3.5                   |                   |      | 3.5         |      | 3.5          |      | V    |
|                 |                           |                       | 1/9                   | <1                        | 10                     | 7                     |                   |      | 7           |      | 7            |      |      |
|                 |                           |                       | 1.5/13.5              | <1                        | 15                     | 11                    |                   |      | 11          |      | 11           |      |      |
| V <sub>IL</sub> | Low Level Input Voltage   |                       | 4.5/0.5               | <1                        | 5                      |                       |                   | 1.5  |             | 1.5  |              | 1.5  | V    |
|                 |                           |                       | 9/1                   | <1                        | 10                     |                       |                   | 3    |             | 3    |              | 3    |      |
|                 |                           |                       | 13.5/1.5              | <1                        | 15                     |                       |                   | 4    |             | 4    |              | 4    |      |
| I <sub>OH</sub> | Output Drive Current      | 0/5                   | 2.5                   | <1                        | 5                      | -1.36                 | -3.2              |      | -1.1        |      | -1.1         |      | mA   |
|                 |                           | 0/5                   | 4.6                   | <1                        | 5                      | -0.44                 | -1                |      | -0.36       |      | -0.36        |      |      |
|                 |                           | 0/10                  | 9.5                   | <1                        | 10                     | -1.1                  | -2.6              |      | -0.9        |      | -0.9         |      |      |
|                 |                           | 0/15                  | 13.5                  | <1                        | 15                     | -3.0                  | -6.8              |      | -2.4        |      | -2.4         |      |      |
| I <sub>OL</sub> | Output Sink Current       | 0/5                   | 0.4                   | <1                        | 5                      | 0.44                  | 1                 |      | 0.36        |      | 0.36         |      | mA   |
|                 |                           | 0/10                  | 0.5                   | <1                        | 10                     | 1.1                   | 2.6               |      | 0.9         |      | 0.9          |      |      |
|                 |                           | 0/15                  | 1.5                   | <1                        | 15                     | 3.0                   | 6.8               |      | 2.4         |      | 2.4          |      |      |
| I <sub>I</sub>  | Input Leakage Current     | 0/18                  | Any Input             |                           | 18                     |                       | ±10 <sup>-5</sup> | ±0.1 |             | ±1   |              | ±1   | μA   |
| C <sub>I</sub>  | Input Capacitance         |                       | Any Input             |                           |                        |                       | 5                 | 7.5  |             |      |              |      | pF   |

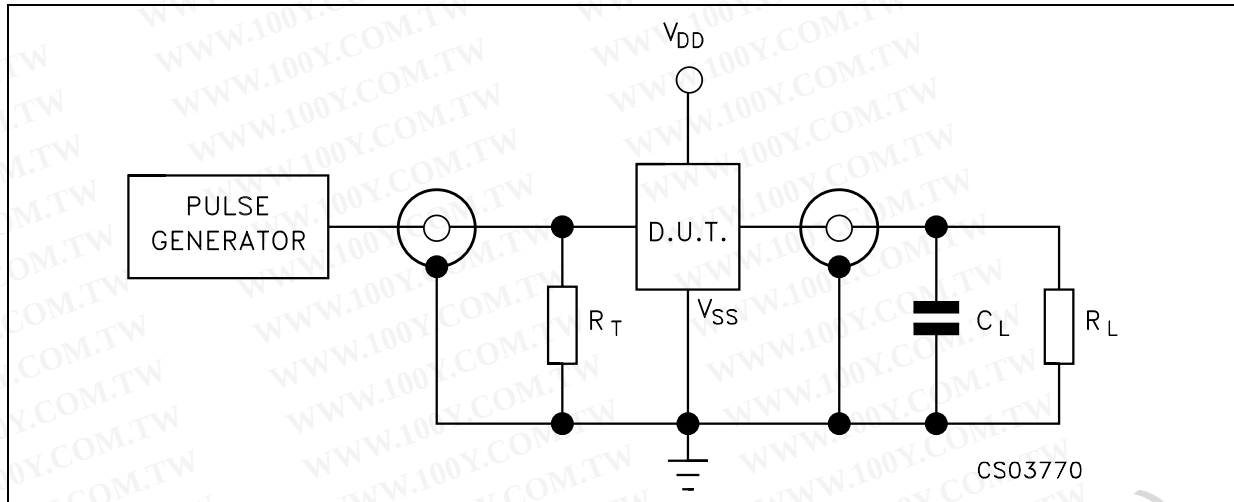
The Noise Margin for both "1" and "0" level is: 1V min. with V<sub>DD</sub>=5V, 2V min. with V<sub>DD</sub>=10V, 2.5V min. with V<sub>DD</sub>=15V

**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{K}\Omega$ ,  $t_r = t_f = 20\text{ ns}$ )

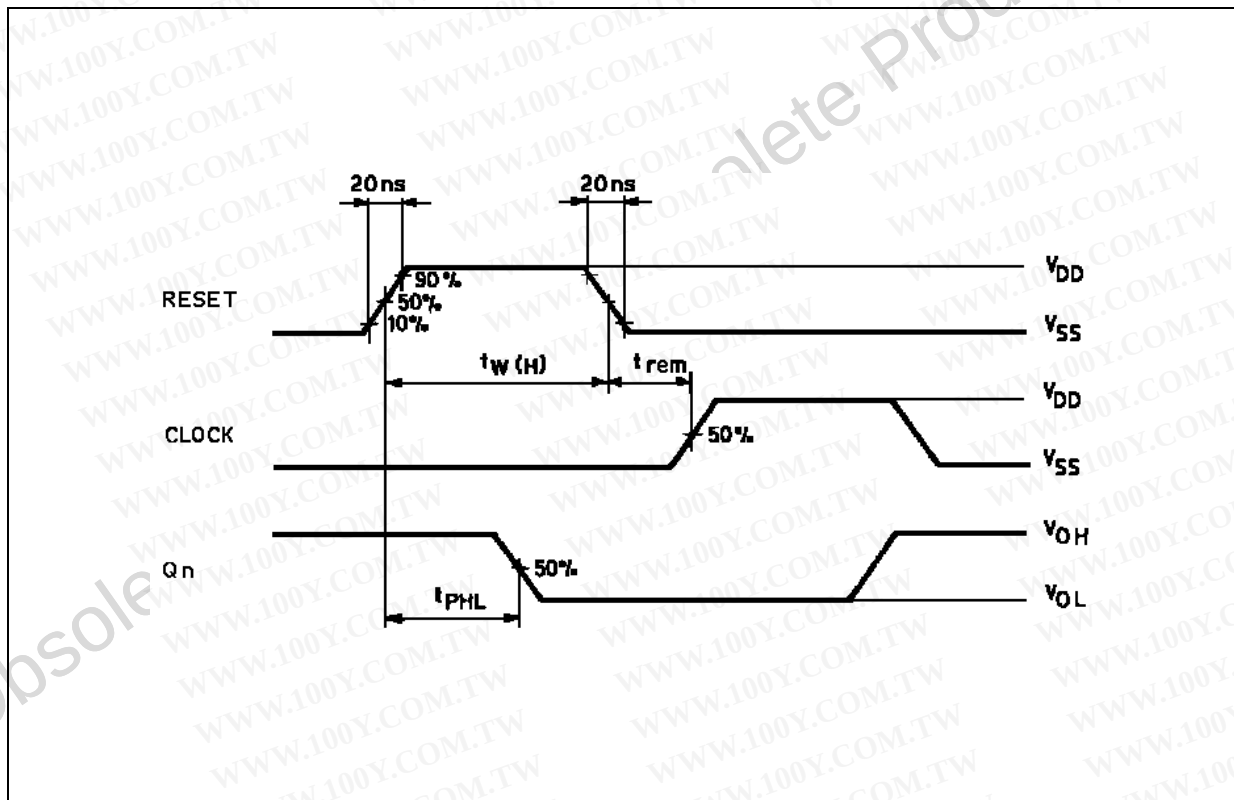
| Symbol              | Parameter                                           | Test Condition |  | Value (*) |      |      | Unit          |
|---------------------|-----------------------------------------------------|----------------|--|-----------|------|------|---------------|
|                     |                                                     | $V_{DD}$ (V)   |  | Min.      | Typ. | Max. |               |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time<br>Clock or Enable to Output | 5              |  |           | 280  | 560  | ns            |
|                     |                                                     | 10             |  |           | 115  | 230  |               |
|                     |                                                     | 15             |  |           | 80   | 160  |               |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time<br>Reset to Output           | 5              |  |           | 330  | 650  | ns            |
|                     |                                                     | 10             |  |           | 130  | 225  |               |
|                     |                                                     | 15             |  |           | 90   | 170  |               |
| $t_{TLH}$ $t_{THL}$ | Transition Time                                     | 5              |  |           | 100  | 200  | ns            |
|                     |                                                     | 10             |  |           | 50   | 100  |               |
|                     |                                                     | 15             |  |           | 40   | 80   |               |
| $t_w$               | Clock Pulse Width                                   | 5              |  | 200       | 100  |      | ns            |
|                     |                                                     | 10             |  | 100       | 50   |      |               |
|                     |                                                     | 15             |  | 70        | 35   |      |               |
| $t_w$               | Reset Pulse Width                                   | 5              |  | 250       | 125  |      | ns            |
|                     |                                                     | 10             |  | 110       | 55   |      |               |
|                     |                                                     | 15             |  | 80        | 40   |      |               |
| $t_w$               | Enable Pulse Width                                  | 5              |  | 400       | 200  |      | ns            |
|                     |                                                     | 10             |  | 200       | 100  |      |               |
|                     |                                                     | 15             |  | 140       | 70   |      |               |
| $t_r$ , $t_f$       | Clock or Enable Rise and<br>Fall Time               | 5              |  |           |      | 15   | $\mu\text{s}$ |
|                     |                                                     | 10             |  |           |      | 15   |               |
|                     |                                                     | 15             |  |           |      | 5    |               |
| $f_{MAX}$           | Maximum Clock<br>Frequency                          | 5              |  | 1.5       | 3    |      | MHz           |
|                     |                                                     | 10             |  | 3         | 6    |      |               |
|                     |                                                     | 15             |  | 4         | 8    |      |               |
| $t_r$ , $t_f$       | Clock or Enable Rise and<br>Fall Time               | 5              |  |           |      | 15   | $\mu\text{s}$ |
|                     |                                                     | 10             |  |           |      | 5    |               |
|                     |                                                     | 15             |  |           |      | 5    |               |

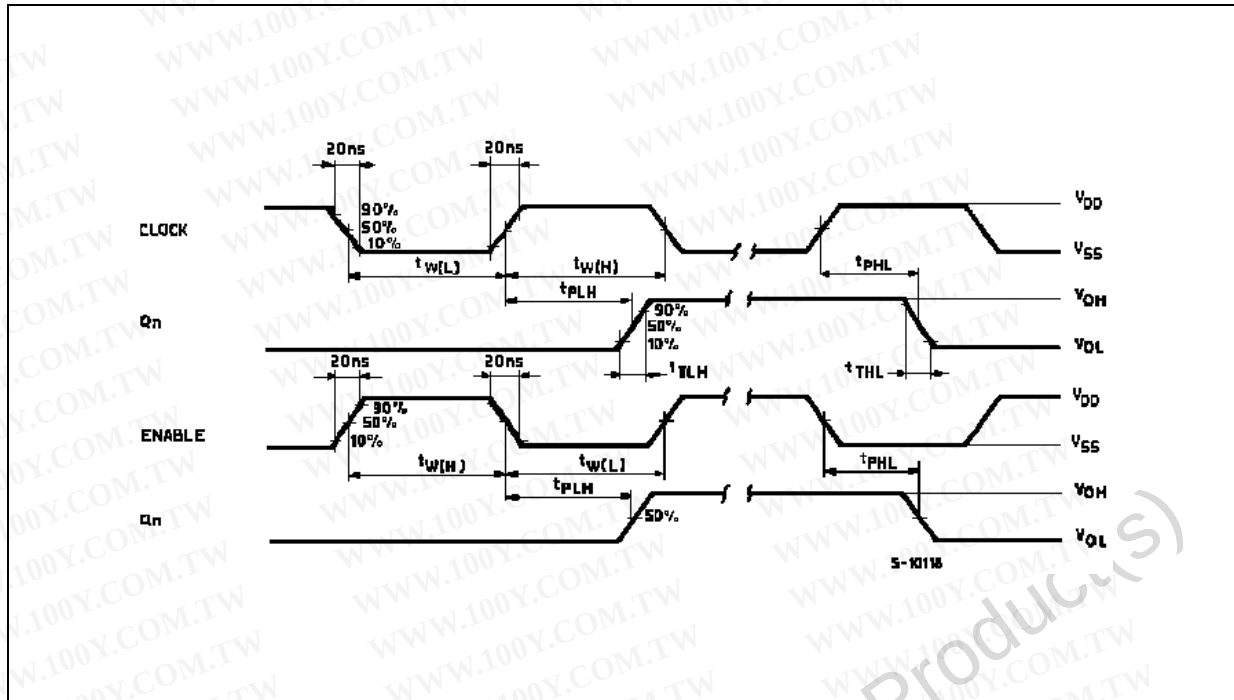
(\*) Typical temperature coefficient for all  $V_{DD}$  value is 0.3 %/°C.

## TEST CIRCUIT



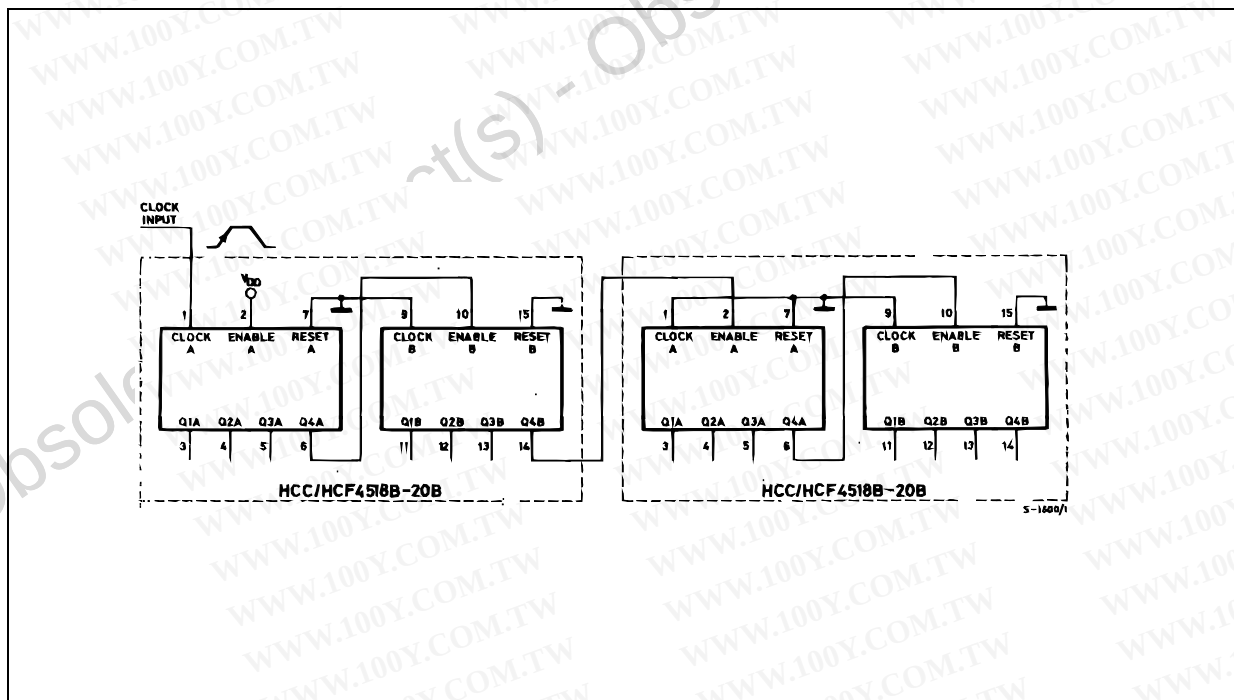
$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = 200\text{k}\Omega$   
 $R_T = Z_{\text{OUT}}$  of pulse generator (typically  $50\Omega$ )

WAVEFORM 1 : MINIMUM PULSE WIDTH AND REMOVAL TIME ( $f=1\text{MHz}$ ; 50% duty cycle)

WAVEFORM 2 : PROPAGATION DELAY TIME, MINIMUM PULSE WIDTH ( $f=1\text{MHz}$ ; 50% duty cycle)

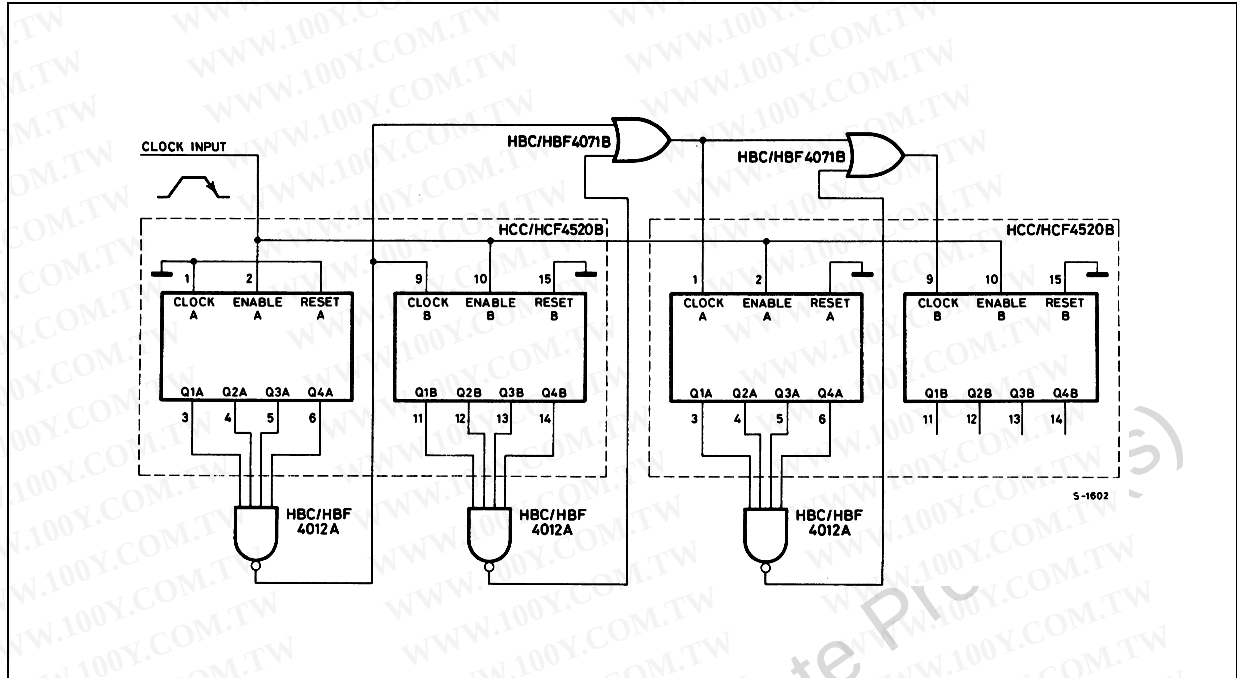
## TYPICAL APPLICATION

RIPPLE CASCADING OF FOUR COUNTERS WITH POSITIVE-EDGE TRIGGERING



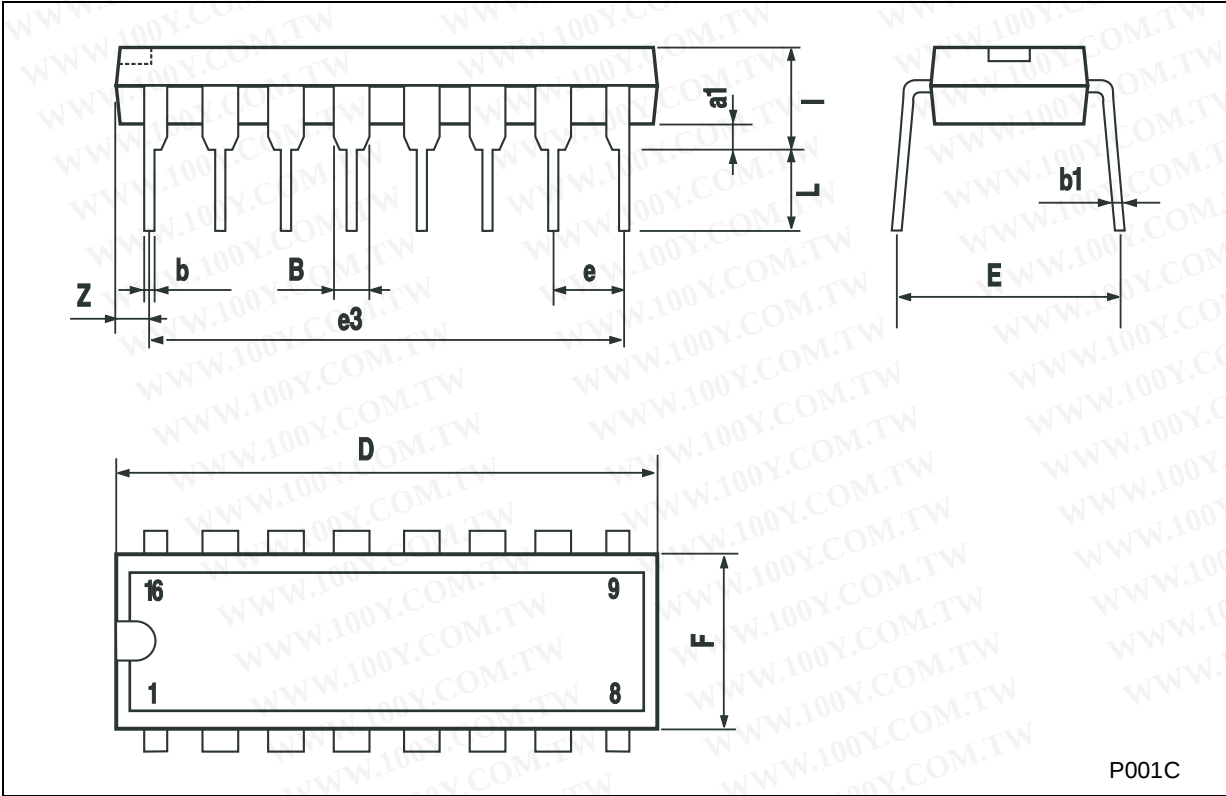
## TYPICAL APPLICATION

## SYNCHRONOUS CASCADING OF 4 BINARY COUNTERS WITH NEGATIVE-EDGE TRIGGERING



Plastic DIP-16 (0.25) MECHANICAL DATA

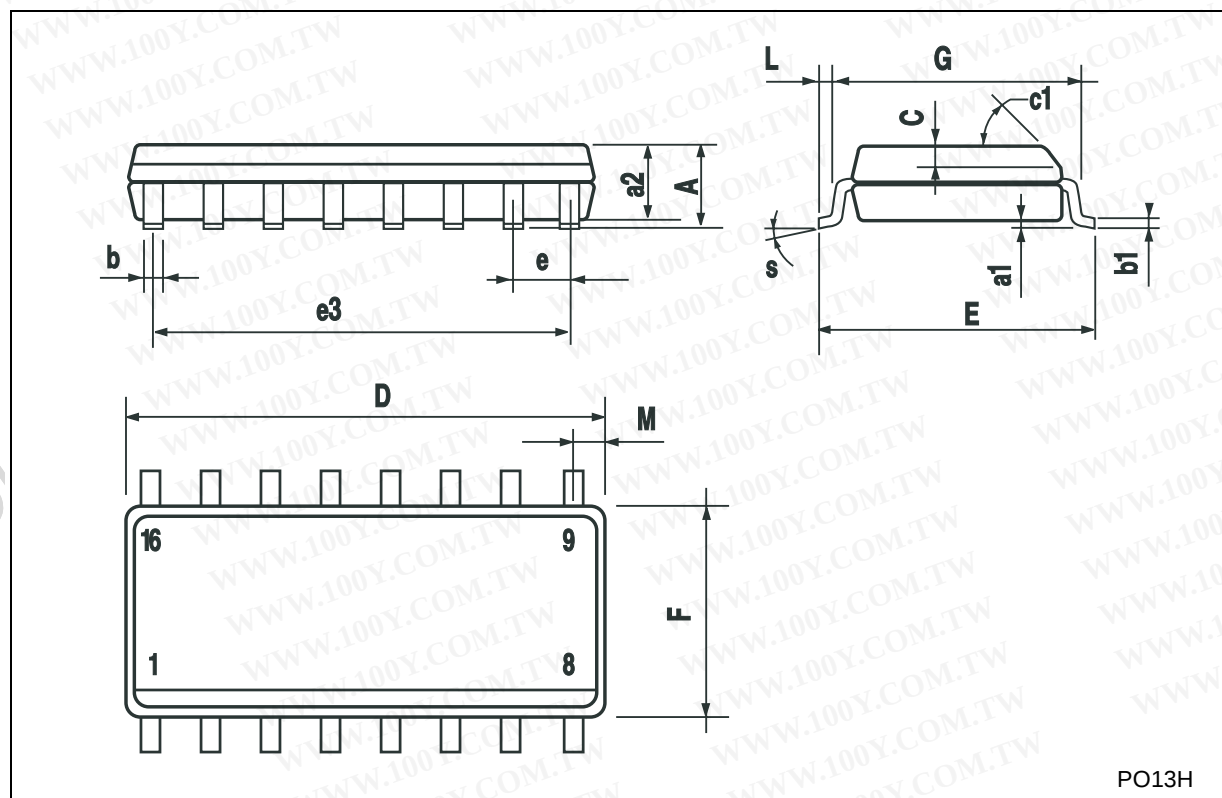
| DIM. | mm.  |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP   | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |      |       | 0.020 |       |
| b1   |      | 0.25  |      |       | 0.010 |       |
| D    |      |       | 20   |       |       | 0.787 |
| E    |      | 8.5   |      |       | 0.335 |       |
| e    |      | 2.54  |      |       | 0.100 |       |
| e3   |      | 17.78 |      |       | 0.700 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    |      |       | 1.27 |       |       | 0.050 |



P001C

## SO-16 MECHANICAL DATA

| DIM. | mm.        |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.003 |       | 0.007 |
| a2   |            |      | 1.65 |       |       | 0.064 |
| b    | 0.35       |      | 0.46 | 0.013 |       | 0.018 |
| b1   | 0.19       |      | 0.25 | 0.007 |       | 0.010 |
| C    |            | 0.5  |      |       | 0.019 |       |
| c1   | 45° (typ.) |      |      |       |       |       |
| D    | 9.8        |      | 10   | 0.385 |       | 0.393 |
| E    | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e    |            | 1.27 |      |       | 0.050 |       |
| e3   |            | 8.89 |      |       | 0.350 |       |
| F    | 3.8        |      | 4.0  | 0.149 |       | 0.157 |
| G    | 4.6        |      | 5.3  | 0.181 |       | 0.208 |
| L    | 0.5        |      | 1.27 | 0.019 |       | 0.050 |
| M    |            |      | 0.62 |       |       | 0.024 |
| S    | 8° (max.)  |      |      |       |       |       |



PO13H

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