



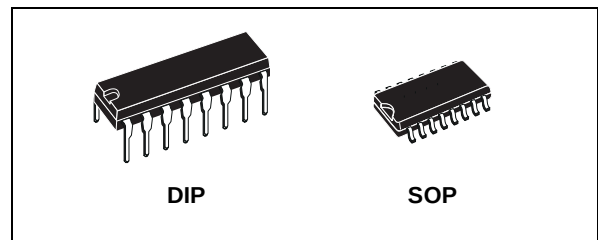
# HCF40192B

## PRESETTABLE UP/DOWN COUNTER (DUAL CLOCK WITH RESET) BCD TYPE

- INDIVIDUAL CLOCK LINES FOR COUNTING UP OR COUNTING DOWN
- SYNCHRONOUS HIGH-SPEED CARRY AND BORROW PROPAGATION DELAYS FOR CASCADING
- ASYNCHRONOUS RESET AND PRESET CAPABILITY
- MEDIUM-SPEED OPERATION -  $f_{CL} = 8\text{MHz}$  (typ.) AT 10 V
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 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"

### DESCRIPTION

HCF40192B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages. HCF40192B Presettable BCD Up/Down Counter consists of 4 synchronously clocked, GATED "D" type flip-flops connected as a counter. The inputs consist of four individual jam lines, a PRESET ENABLE control, individual CLOCK UP and CLOCK DOWN signals and a master RESET. Four buffered Q signal outputs, as well as CARRY

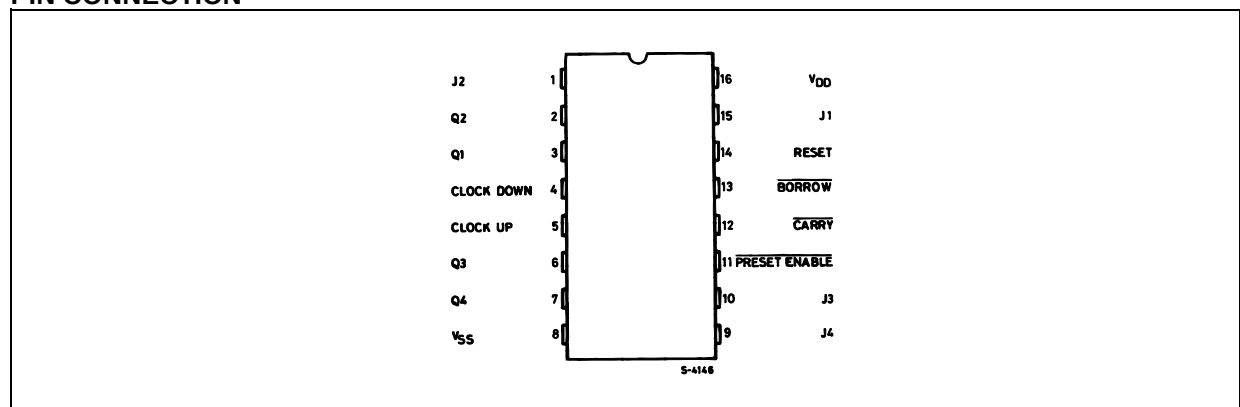


### ORDER CODES

| PACKAGE | TUBE        | T & R          |
|---------|-------------|----------------|
| DIP     | HCF40192BEY |                |
| SOP     | HCF40192BM1 | HCF40192M013TR |

and BORROW outputs for multiple-stage counting schemes, are provided. The counter is cleared so that all outputs are in a low state by a high on the RESET line. A RESET is accomplished asynchronously with the clock. Each output is individually programmable asynchronously with the clock to the level on the corresponding jam input when the PRESET ENABLE control is low. The counter counts up one count on the positive clock edge of the CLOCK UP signal, provided the CLOCK DOWN line is high. The counter counts down one count on the positive clock edge of the CLOCK DOWN signal provided the CLOCK UP line is high. The CARRY and BORROW signals are high when the counter is counts up or down. The CARRY signal goes low one-half clock cycle after the counter reaches its maximum count in the count-up mode. The BORROW signal goes

### PIN CONNECTION

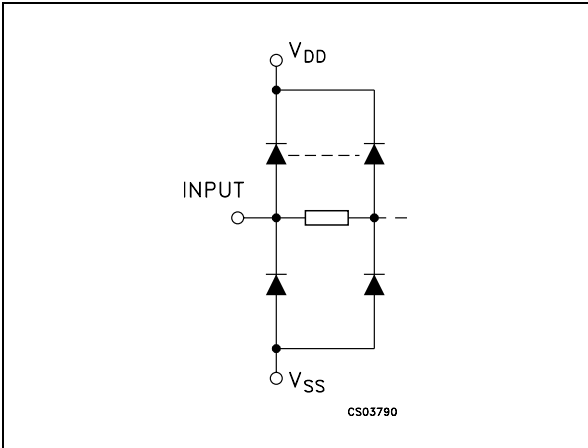


HCF40192B

low one-half clock cycle after the counter reaches its minimum count in the count-down mode. The cascading of multiple packages is easily accomplished without the need for additional

external circuitry by tying the BORROW and CARRY outputs to the CLOCK DOWN and CLOCK UP inputs, respectively, of the following package.

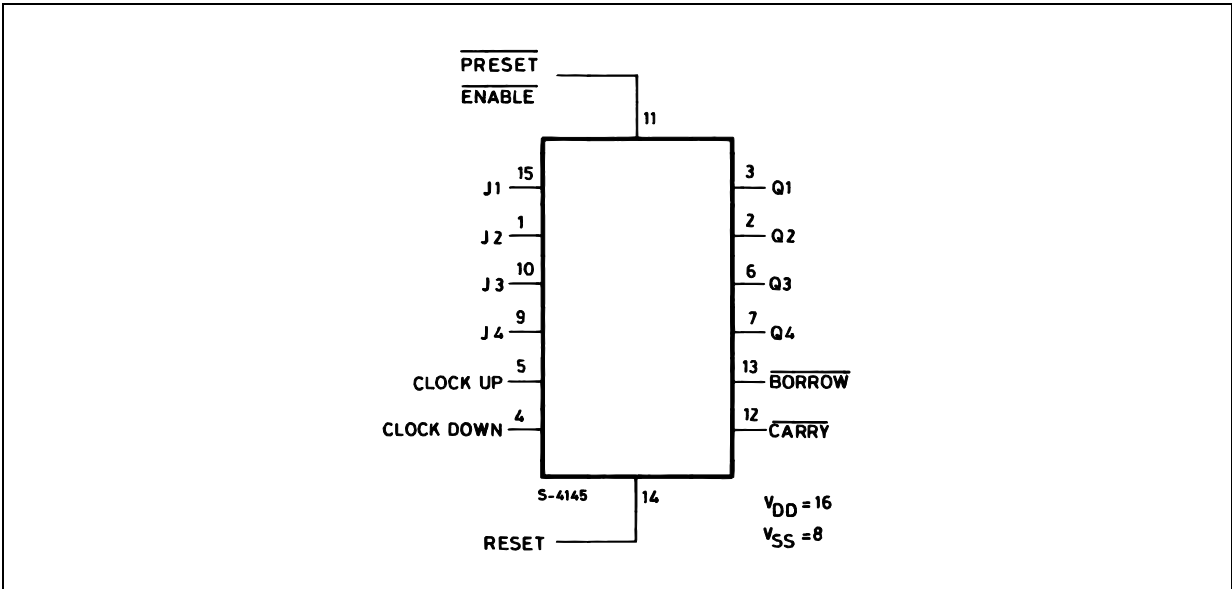
IINPUT EQUIVALENT CIRCUIT



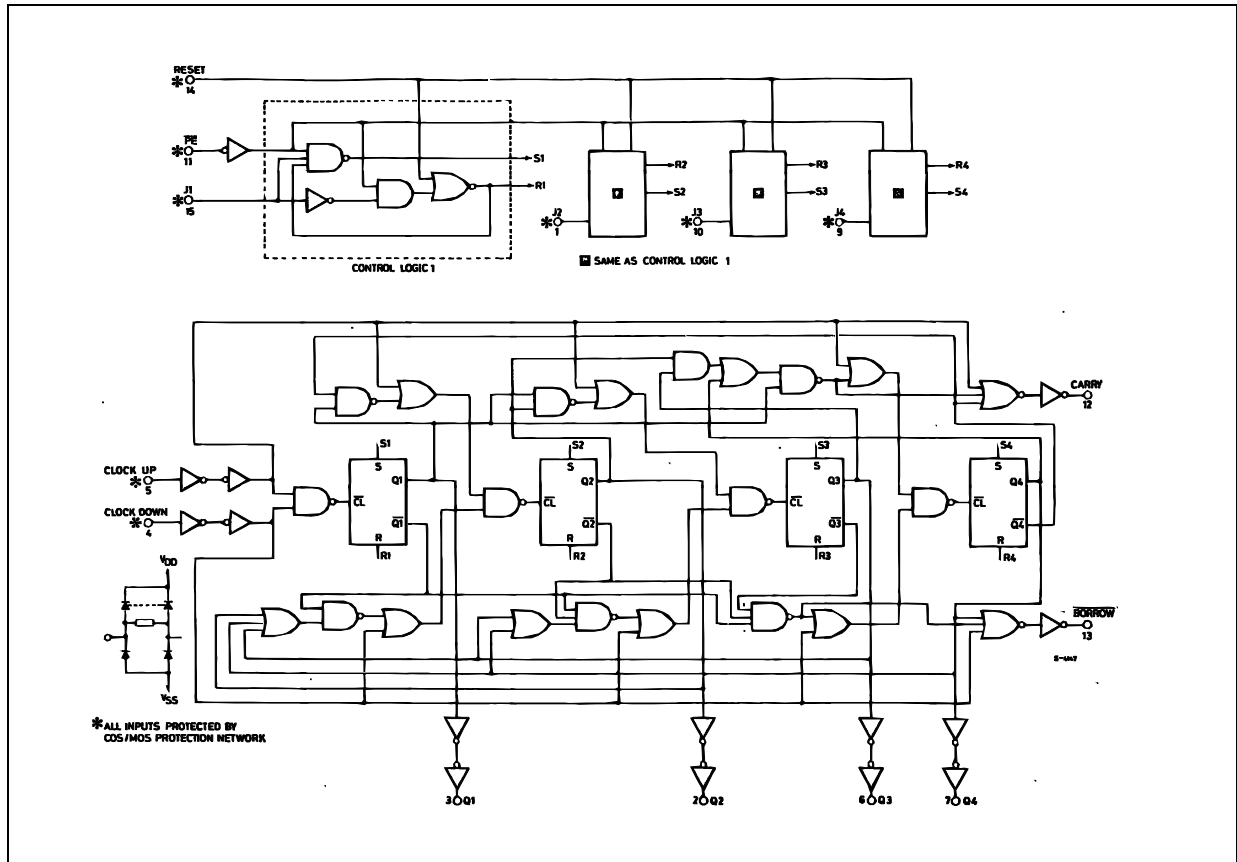
PIN DESCRIPTION

| PIN No       | SYMBOL               | NAME AND FUNCTION       |
|--------------|----------------------|-------------------------|
| 3, 2, 6, 7   | Q1 to Q4             | Flip-Flop Outputs       |
| 4            | CLOCK DOWN           | Clock Down Input        |
| 5            | CLOCK UP             | Clock Up Input          |
| 11           | <u>PRESET ENABLE</u> | Preset Enable Input     |
| 12           | <u>CARRY</u>         | Count Up (Carry)        |
| 13           | <u>BORROW</u>        | Count Down (Borrow)     |
| 14           | RESET                | Reset Input             |
| 15, 1, 10, 9 | J1 to J4             | Data Input              |
| 8            | VSS                  | Negative Supply Voltage |
| 16           | VDD                  | Positive Supply Voltage |

FUNCTIONAL DIAGRAM



## LOGIC DIAGRAM

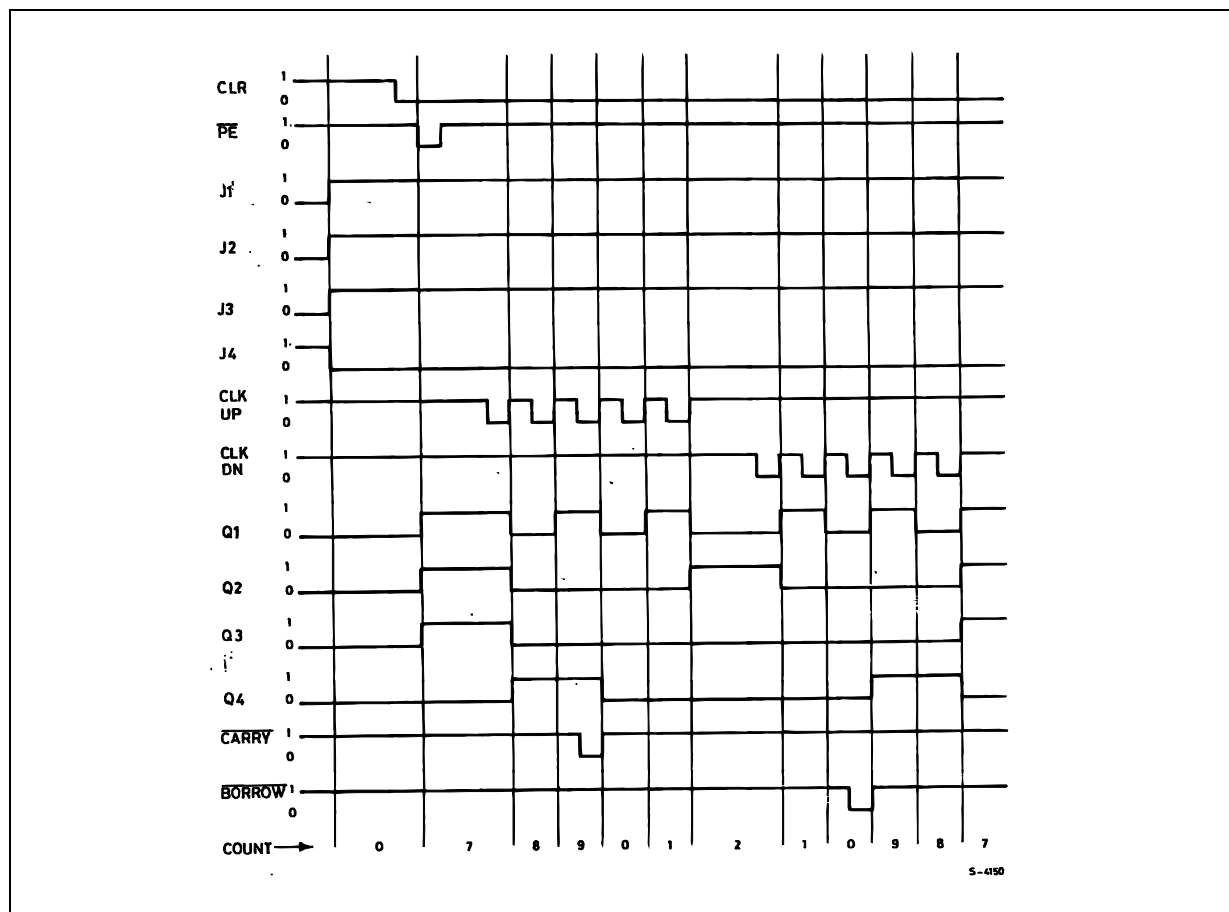


## TRUTH TABLE

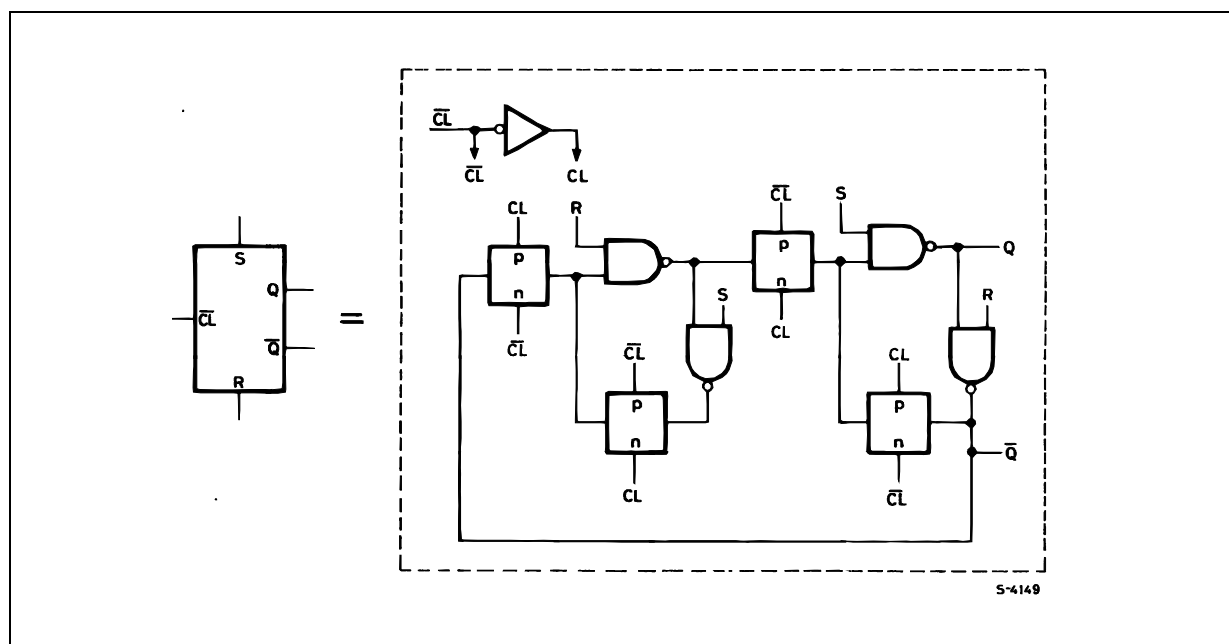
| CLOCK UP | CLOCK DOWN | PRESET ENABLE | RESET | ACTION     |
|----------|------------|---------------|-------|------------|
|          | H          | H             | L     | COUNT UP   |
|          | H          | H             | L     | NO COUNT   |
| H        |            | H             | L     | COUNT DOWN |
| H        |            | H             | L     | NO COUNT   |
| X        | X          | L             | L     | PRESET     |
| X        | X          | X             | H     | RESET      |

(X) : Don't Care

## TIMING DIAGRAM



## INTERNAL LOGIC FLIP-FLOP



**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>O</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 |      |

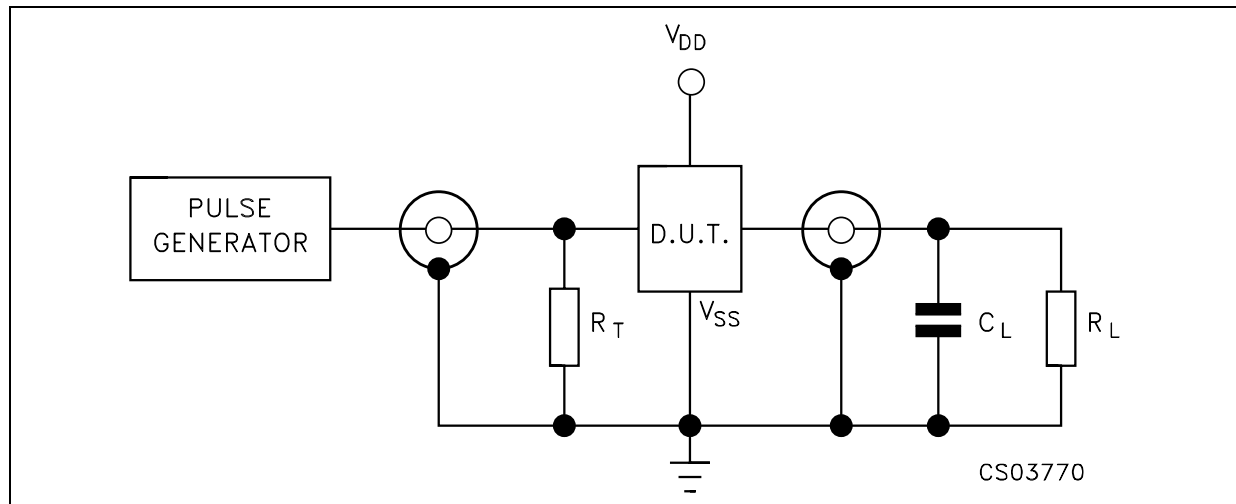
The Noise Margin for both "1" and "0" level is: 1V min. with V<sub>DD</sub>=5V, 2V min. with V<sub>DD</sub>=10V, 2.5V min. with V<sub>DD</sub>=15V

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

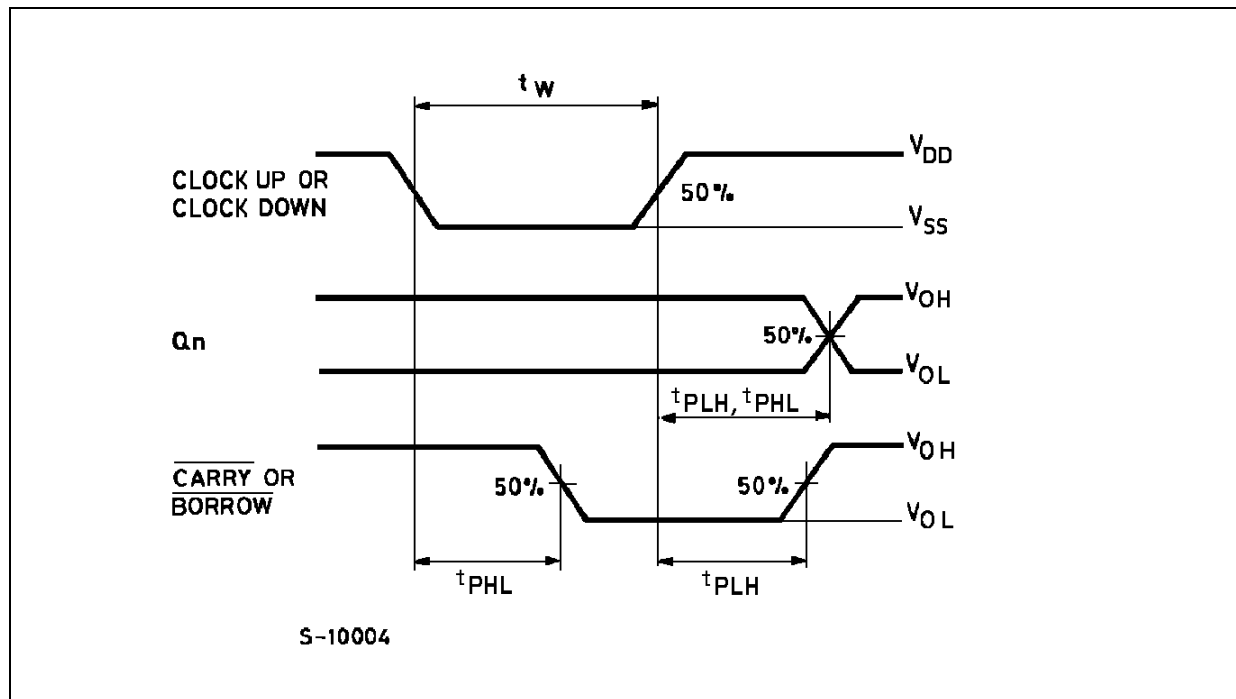
| Symbol              | Parameter                                                                                                         | Test Condition |  | Value (*) |      |      | Unit          |
|---------------------|-------------------------------------------------------------------------------------------------------------------|----------------|--|-----------|------|------|---------------|
|                     |                                                                                                                   | $V_{DD}$ (V)   |  | Min.      | Typ. | Max. |               |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time<br>Clock Up or Clock Down to<br>Q Reset to Q                                               | 5              |  |           | 250  | 500  | ns            |
|                     |                                                                                                                   | 10             |  |           | 120  | 240  |               |
|                     |                                                                                                                   | 15             |  |           | 90   | 180  |               |
|                     | PE to Q                                                                                                           | 5              |  |           | 200  | 400  | ns            |
|                     |                                                                                                                   | 10             |  |           | 100  | 200  |               |
|                     |                                                                                                                   | 15             |  |           | 70   | 140  |               |
|                     | Clock Up to $\overline{\text{Carry}}$<br>Clock Down to $\overline{\text{Borrow}}$                                 | 5              |  |           | 160  | 320  | ns            |
|                     |                                                                                                                   | 10             |  |           | 80   | 160  |               |
|                     |                                                                                                                   | 15             |  |           | 60   | 120  |               |
|                     | $\overline{\text{Reset}}$ or $\overline{\text{PR}}$ to $\overline{\text{Borrow}}$ or<br>$\overline{\text{Carry}}$ | 5              |  |           | 300  | 600  | ns            |
|                     |                                                                                                                   | 10             |  |           | 150  | 300  |               |
|                     |                                                                                                                   | 15             |  |           | 110  | 220  |               |
| $t_{THL}$ $t_{TLH}$ | Transition Time                                                                                                   | 5              |  |           | 100  | 200  | ns            |
|                     |                                                                                                                   | 10             |  |           | 50   | 100  |               |
|                     |                                                                                                                   | 15             |  |           | 40   | 80   |               |
| $t_{rem}^*$         | Removal Time<br>$\overline{\text{Reset}}$ or $\overline{\text{PE}}$                                               | 5              |  | 80        | 40   |      | ns            |
|                     |                                                                                                                   | 10             |  | 40        | 20   |      |               |
|                     |                                                                                                                   | 15             |  | 30        | 15   |      |               |
| $t_W$               | Clock Input Pulse Width<br>Reset                                                                                  | 5              |  | 480       | 240  |      | ns            |
|                     |                                                                                                                   | 10             |  | 300       | 150  |      |               |
|                     |                                                                                                                   | 15             |  | 260       | 130  |      |               |
|                     | $\overline{\text{PE}}$                                                                                            | 5              |  |           | 120  | 240  | ns            |
|                     |                                                                                                                   | 10             |  |           | 85   | 170  |               |
|                     |                                                                                                                   | 15             |  |           | 70   | 140  |               |
|                     | Clock                                                                                                             | 5              |  |           | 90   | 180  | ns            |
|                     |                                                                                                                   | 10             |  |           | 45   | 90   |               |
|                     |                                                                                                                   | 15             |  |           | 30   | 60   |               |
| $t_r$ $t_f$         | Clock Input Rise or Fall<br>Time                                                                                  | 5              |  |           |      | 15   | $\mu\text{s}$ |
|                     |                                                                                                                   | 10             |  |           |      | 15   |               |
|                     |                                                                                                                   | 15             |  |           |      | 5    |               |
| $f_{CL}$            | Maximum Clock Input<br>Frequency                                                                                  | 5              |  | 2         | 4    |      | MHz           |
|                     |                                                                                                                   | 10             |  | 5         | 8    |      |               |
|                     |                                                                                                                   | 15             |  | 5.5       | 11   |      |               |

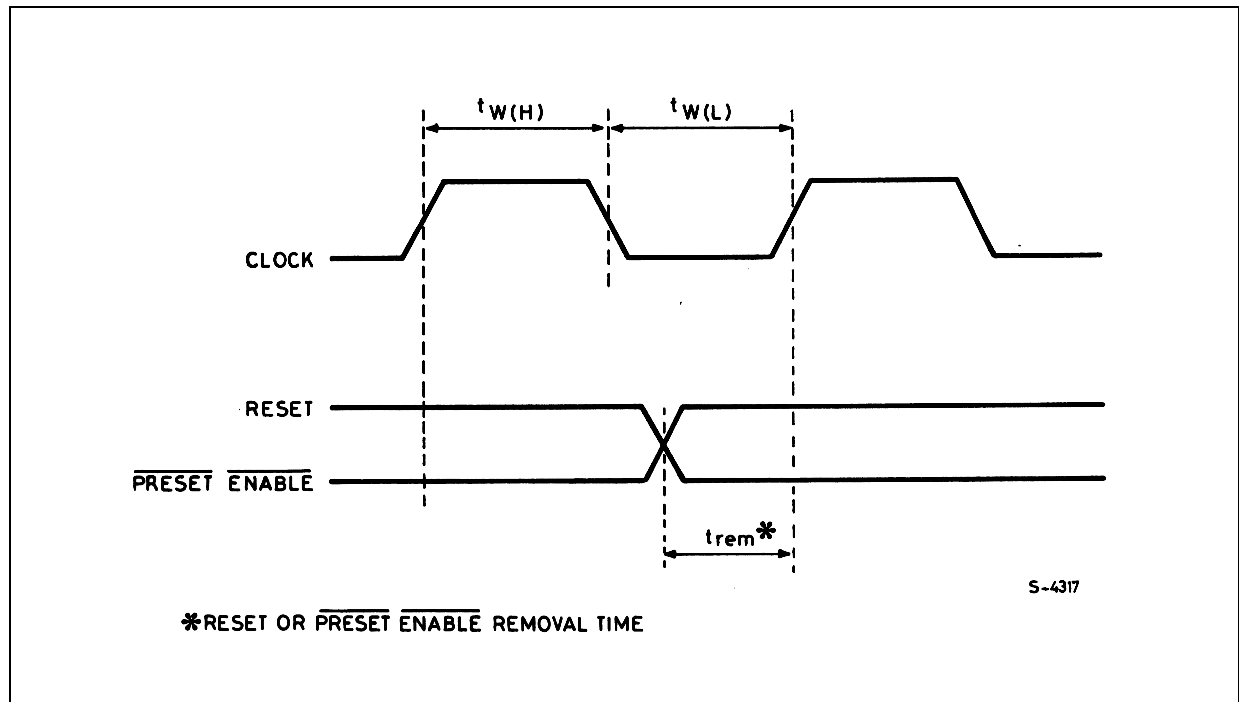
(\*) The time required for Reset or Preset Enable control to be removed before clocking (see timing diagram).

## TEST CIRCUIT

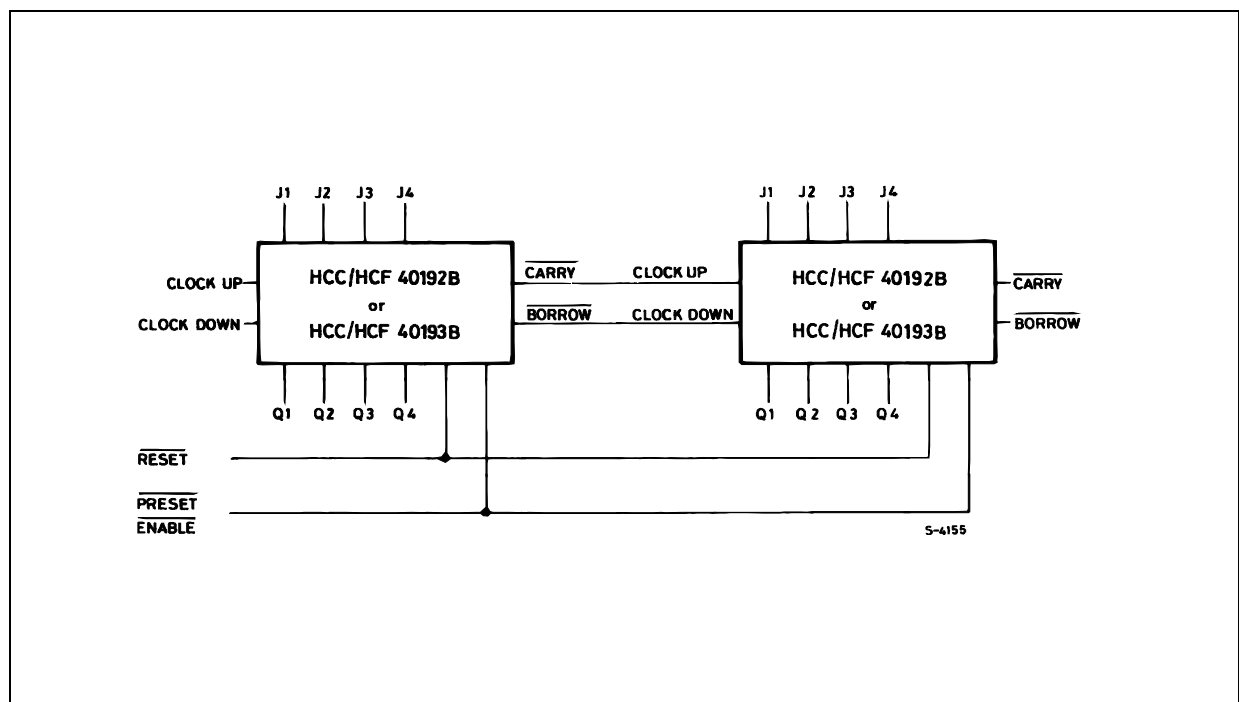


$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = 200\text{k}\Omega$   
 $R_T = Z_{\text{OUT}}$  of pulse generator (typically  $50\Omega$ )

WAVEFORM 1 : PROPAGATION DELAY TIMES ( $f=1\text{MHz}$ ; 50% duty cycle)

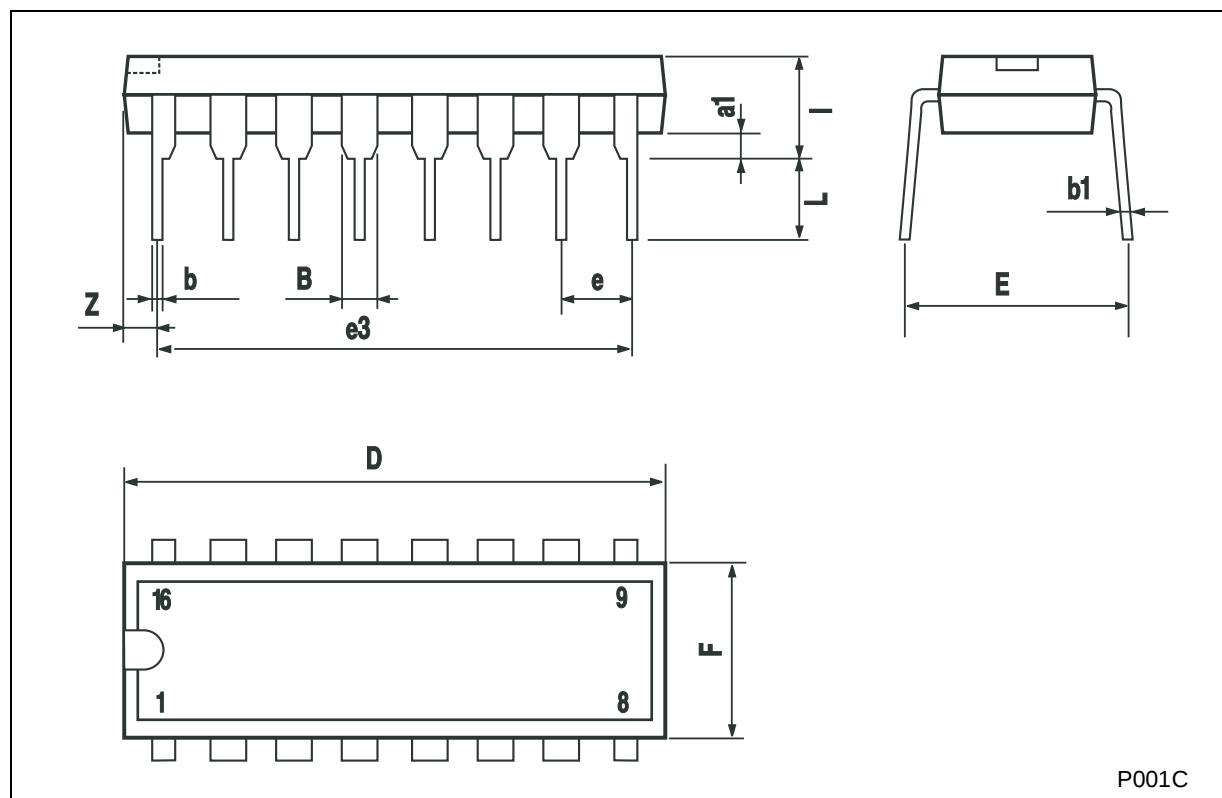
WAVEFORM 2 : MINIMUM PULSE WIDTH AND REMOVAL TIME ( $f=1\text{MHz}$ ; 50% duty cycle)

## TYPICAL APPLICATION: CASCADED COUNTER PACKAGES



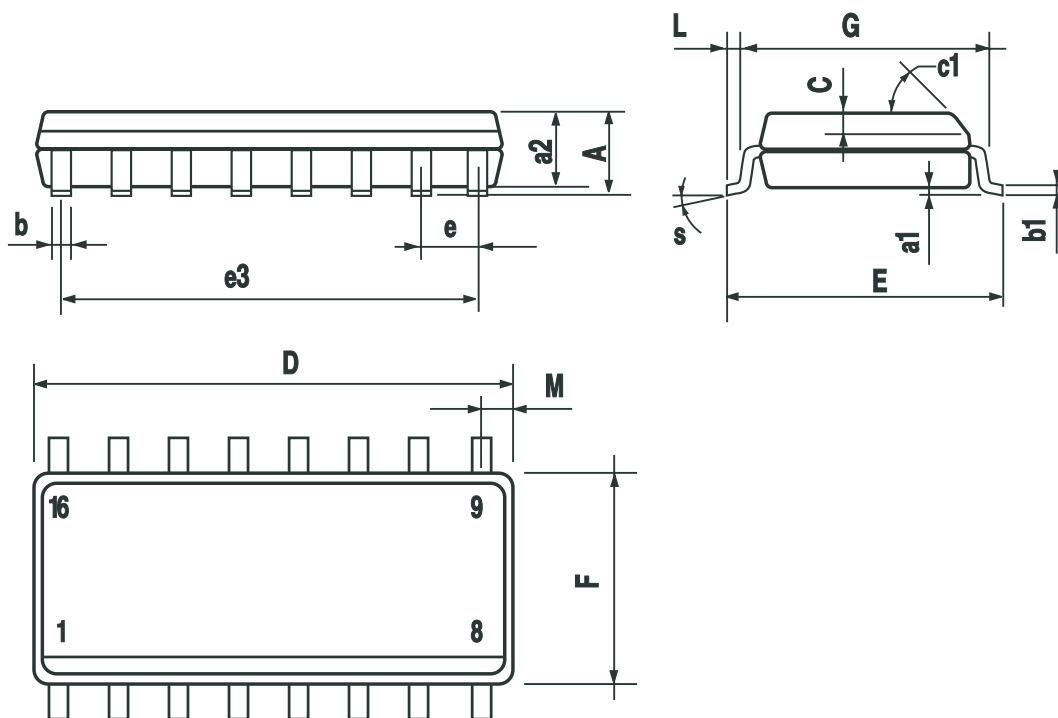
### Plastic DIP-16 (0.25) MECHANICAL DATA

| 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 |



## 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.)  |      |      |       |       |       |



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