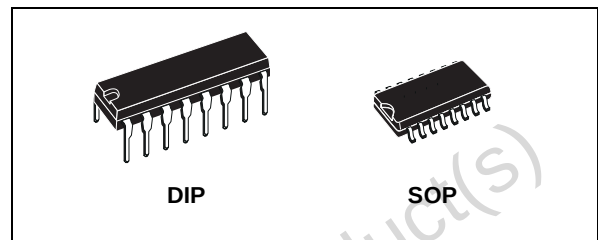




## HCF40103B

### 8-STAGE PRESETTABLE SYNCHRONOUS 8 BIT BINARY DOWN COUNTERS

- SYNCHRONOUS OR ASYNCHRONOUS PRESET
- MEDIUM -SPEED OPERATION :  
 $f_{CL} = 3.6\text{MHz}$  (Typ.) at  $V_{DD} = 10\text{V}$
- CASCADABLE
- 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

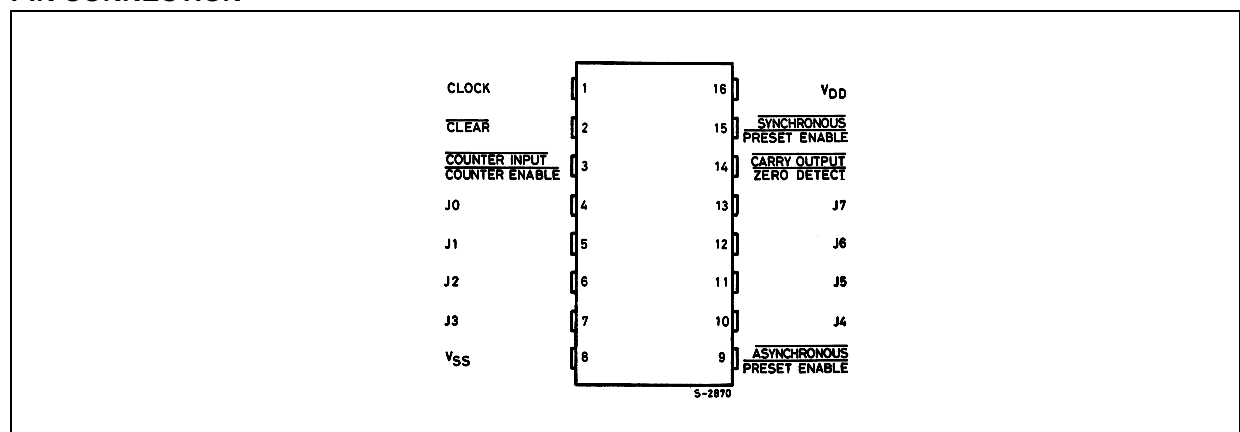
| PACKAGE | TUBE        | T & R          |
|---------|-------------|----------------|
| DIP     | HCF40103BEY |                |
| SOP     | HCF40103BM1 | HCF40103M013TR |

#### DESCRIPTION

HCF40103B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages. HCF40103B consists of an 8-stage synchronous down counter with a single output that is active when the internal count is zero. This device contains a single 8-bit binary counter. It has control inputs for enabling or disabling the clock, for clearing the counter to its maximum count, and for presetting the counter either synchronously or asynchronously. All control inputs and the CARRY-OUT/ZERO DETECT output are active-low logics. In normal operation, the counter is decremented by one count on each positive transition of the CLOCK. Counting is inhibited when the CARRY-IN/COUNTER ENABLE (CI/

CE) input is high. The CARRY-OUT/ZERO DETECT (CO/ZD) output goes low when the count reaches zero if the CI/CE input is low, and remains low for one full clock period. When the SYNCHRONOUS PRESET ENABLE (SPE) input is low, data at the JAM input is clocked into the counter on the next positive clock transition regardless of the state of the CI/CE input. When the ASYNCHRONOUS PRESET ENABLE (APE) input is low, data at the JAM inputs is asynchronously forced into the counter regardless of the state of the SPE, CI/CE, or CLOCK inputs. JAM inputs J0-J7 represent a single 8 bit binary word. When the CLEAR (CLR) input is low, the counter is asynchronously cleared to its maximum count ( $255_{10}$ ) regardless of the state of any other input. The precedent relationship between control input is indicated in the truth table. If all control

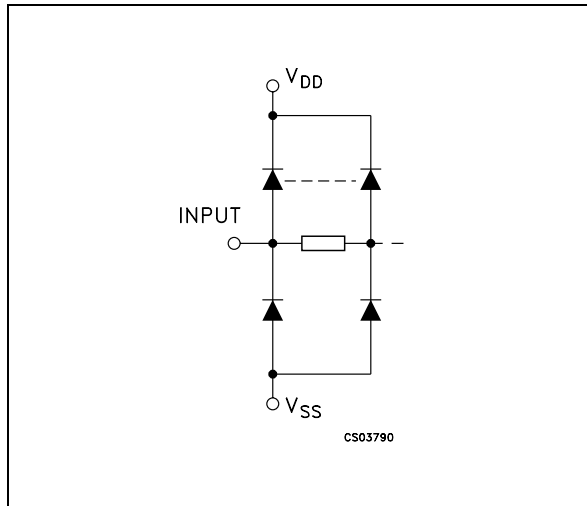
#### PIN CONNECTION



## HCF40103B

inputs are high at the time of zero count, the counters will jump to the maximum count, giving a counting sequence of 256 clock pulses long.

### INPUT EQUIVALENT CIRCUIT

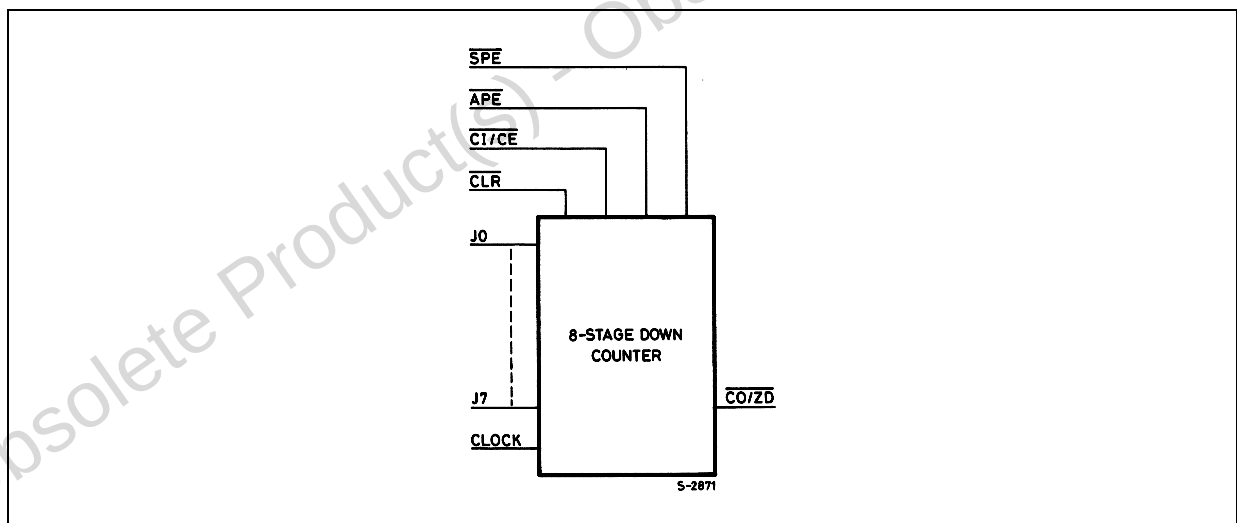


HCF40103B may be cascaded using the  $\overline{\text{CI/CE}}$  input and the  $\overline{\text{CO/ZD}}$  output, in either a synchronous or ripple mode.

### PIN DESCRIPTION

| PIN No                     | SYMBOL                    | NAME AND FUNCTION                              |
|----------------------------|---------------------------|------------------------------------------------|
| 1                          | CLOCK                     | Clock Input (LOW to HIGH edge triggered)       |
| 2                          | $\overline{\text{CLEAR}}$ | Asynchronous Master Reset Input (Active Low)   |
| 3                          | $\overline{\text{CI/CE}}$ | Terminal Enable Input                          |
| 4, 5, 6, 7, 10, 11, 12, 13 | J0 to J7                  | Jam Inputs                                     |
| 9                          | $\overline{\text{APE}}$   | Asynchronous Preset Enable Inputs (Active Low) |
| 14                         | $\overline{\text{CO/ZD}}$ | Terminal Count Output (Active Low)             |
| 15                         | $\overline{\text{SPE}}$   | Synchronous Preset Enable Input (Active Low)   |
| 8                          | $V_{SS}$                  | Negative Supply Voltage                        |
| 16                         | $V_{DD}$                  | Positive Supply Voltage                        |

### FUNCTIONAL DIAGRAM



### TRUTH TABLES

| CONTROL INPUTS          |                         |                         |                           | PRESET MODE  | ACTION                                   |
|-------------------------|-------------------------|-------------------------|---------------------------|--------------|------------------------------------------|
| $\overline{\text{CLR}}$ | $\overline{\text{APE}}$ | $\overline{\text{SPE}}$ | $\overline{\text{CI/CE}}$ |              |                                          |
| H                       | H                       | H                       | H                         | Synchronous  | Inhibit Counter                          |
| H                       | H                       | H                       | L                         |              | Count Down                               |
| H                       | H                       | L                       | X                         |              | Preset on Next Positive Clock Transition |
| H                       | L                       | X                       | X                         | Asynchronous | Preset Asynchronously                    |
| L                       | X                       | X                       | X                         |              | Clear to Maximum Count                   |

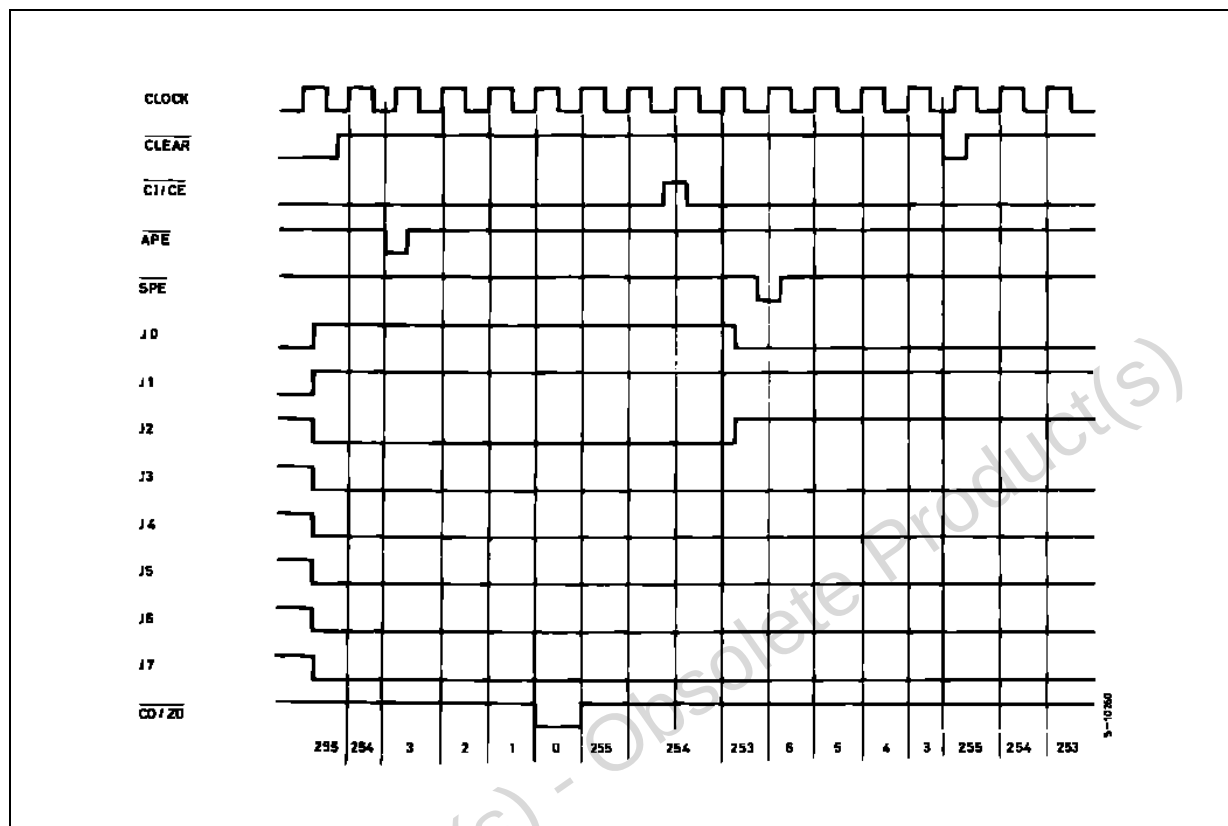
X : Don't Care

Clock connected to Clock input

Synchronous Operation : changes occur on negative to positive clock transitions.



## 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

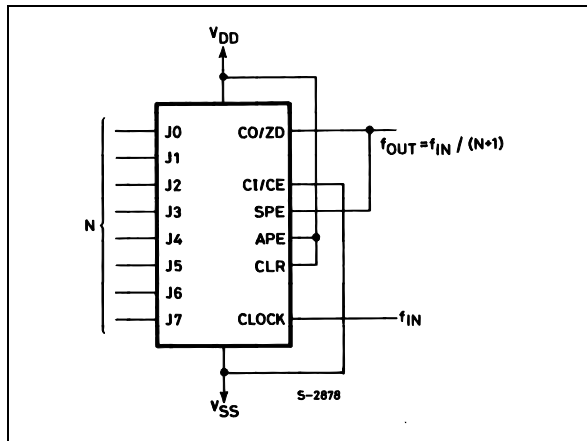
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{K}\Omega$ ,  $t_r = t_f = 20\text{ ns}$ )

| Symbol              | Parameter                                                         | Test Condition |  | Value (*) |      |      | Unit |
|---------------------|-------------------------------------------------------------------|----------------|--|-----------|------|------|------|
|                     |                                                                   | $V_{DD}$ (V)   |  | Min.      | Typ. | Max. |      |
| $t_{PHL}$ $t_{PLH}$ | Propagation Delay Time<br>Clock To Out                            | 5              |  |           | 300  | 600  | ns   |
|                     |                                                                   | 10             |  |           | 130  | 260  |      |
|                     |                                                                   | 15             |  |           | 95   | 190  |      |
| $t_{PHL}$ $t_{PLH}$ | Propagation Delay Time<br>Carry In/counter Enable To<br>Output    | 5              |  |           | 200  | 400  | ns   |
|                     |                                                                   | 10             |  |           | 90   | 180  |      |
|                     |                                                                   | 15             |  |           | 65   | 130  |      |
| $t_{PHL}$ $t_{PLH}$ | Propagation Delay Time<br>Asynchronous Preset<br>Enable To Output | 5              |  |           | 650  | 1300 | ns   |
|                     |                                                                   | 10             |  |           | 300  | 600  |      |
|                     |                                                                   | 15             |  |           | 200  | 400  |      |
| $t_{PHL}$ $t_{PLH}$ | Propagation Delay Time<br>Clear To Output                         | 5              |  |           | 375  | 750  | ns   |
|                     |                                                                   | 10             |  |           | 180  | 360  |      |
|                     |                                                                   | 15             |  |           | 100  | 200  |      |
| $t_{THL}$ $t_{TLH}$ | Transition Time                                                   | 5              |  |           | 100  | 200  | ns   |
|                     |                                                                   | 10             |  |           | 50   | 100  |      |
|                     |                                                                   | 15             |  |           | 40   | 80   |      |
| $t_W$               | Clock Pulse Width                                                 | 5              |  | 300       | 150  |      | ns   |
|                     |                                                                   | 10             |  | 180       | 90   |      |      |
|                     |                                                                   | 15             |  | 80        | 40   |      |      |
| $t_W$               | Clear Pulse Width                                                 | 5              |  | 320       | 160  |      | ns   |
|                     |                                                                   | 10             |  | 160       | 80   |      |      |
|                     |                                                                   | 15             |  | 100       | 50   |      |      |
| $t_W$               | APE Pulse Width                                                   | 5              |  | 360       | 180  |      | ns   |
|                     |                                                                   | 10             |  | 160       | 80   |      |      |
|                     |                                                                   | 15             |  | 120       | 60   |      |      |
| $t_{setup}$         | SPE Setup Time                                                    | 5              |  | 280       | 140  |      | ns   |
|                     |                                                                   | 10             |  | 140       | 70   |      |      |
|                     |                                                                   | 15             |  | 100       | 50   |      |      |
| $t_{setup}$         | JAM Setup Time                                                    | 5              |  | 200       | 100  |      | ns   |
|                     |                                                                   | 10             |  | 80        | 40   |      |      |
|                     |                                                                   | 15             |  | 60        | 30   |      |      |
| $f_{CL}$            | Maximum Clock Input<br>Frequency                                  | 5              |  | 0.7       | 1.4  |      | MHz  |
|                     |                                                                   | 10             |  | 1.8       | 3.6  |      |      |
|                     |                                                                   | 15             |  | 2.4       | 4.8  |      |      |

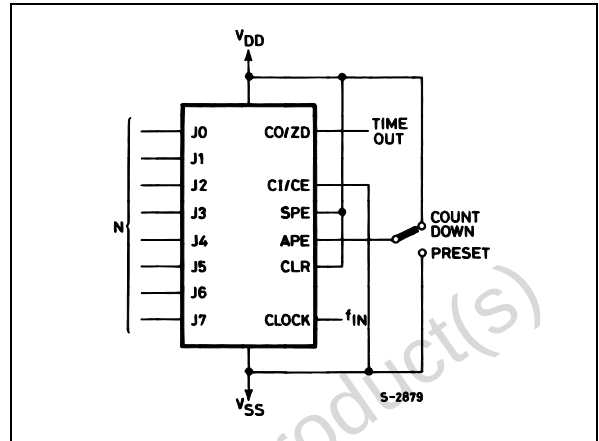
(\*) Typical temperature coefficient for all  $V_{DD}$  value is 0.3 %/°C.

## TYPICAL APPLICATIONS

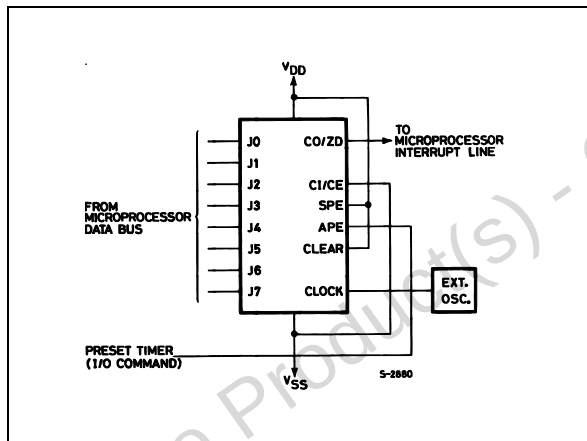
#### DIVIDE BY "N" COUNTER



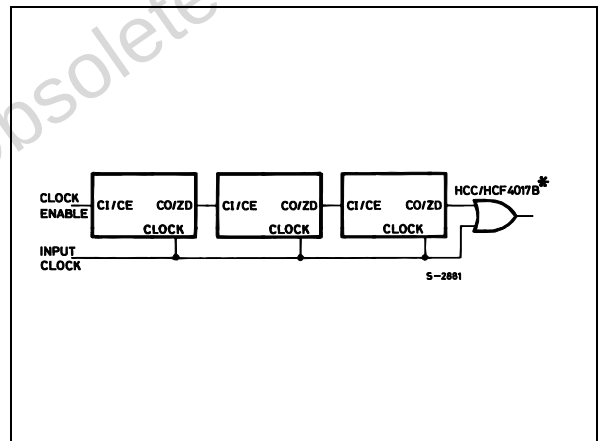
## SYNCHRONOUS CASCADING



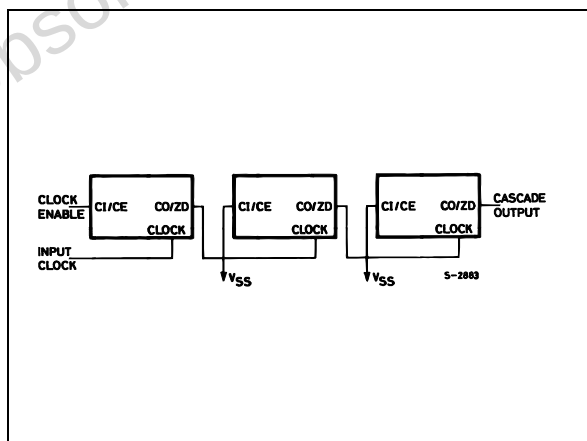
## MICROPROCESSOR INTERRUPT TIMER



## SYNCHRONOUS CASCADING

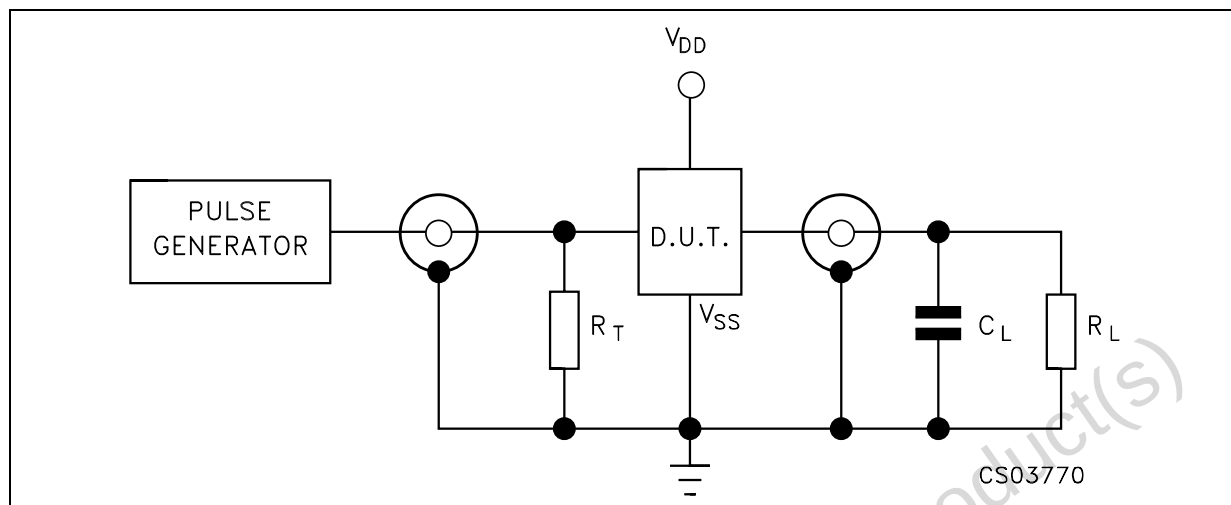


## MICROPROCESSOR INTERRUPT TIMER



\* An Output spike (160ns at  $V_{DD} = 5V$ ) occurs whenever two or more devices are cascaded in the parallel clocked mode because the clock-to-carry out delay is greater than the carry-in-to-carry-out delay. This spike is eliminated by gating the output of the last device with the clock as shown.

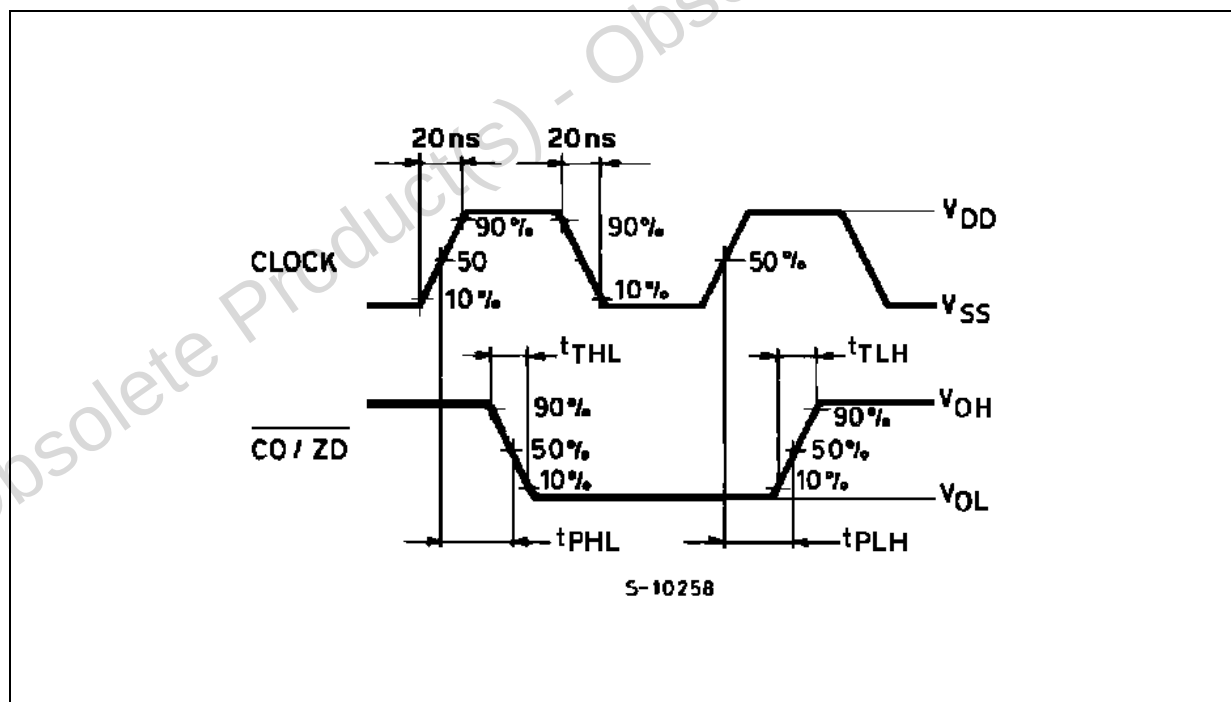
## TEST CIRCUIT



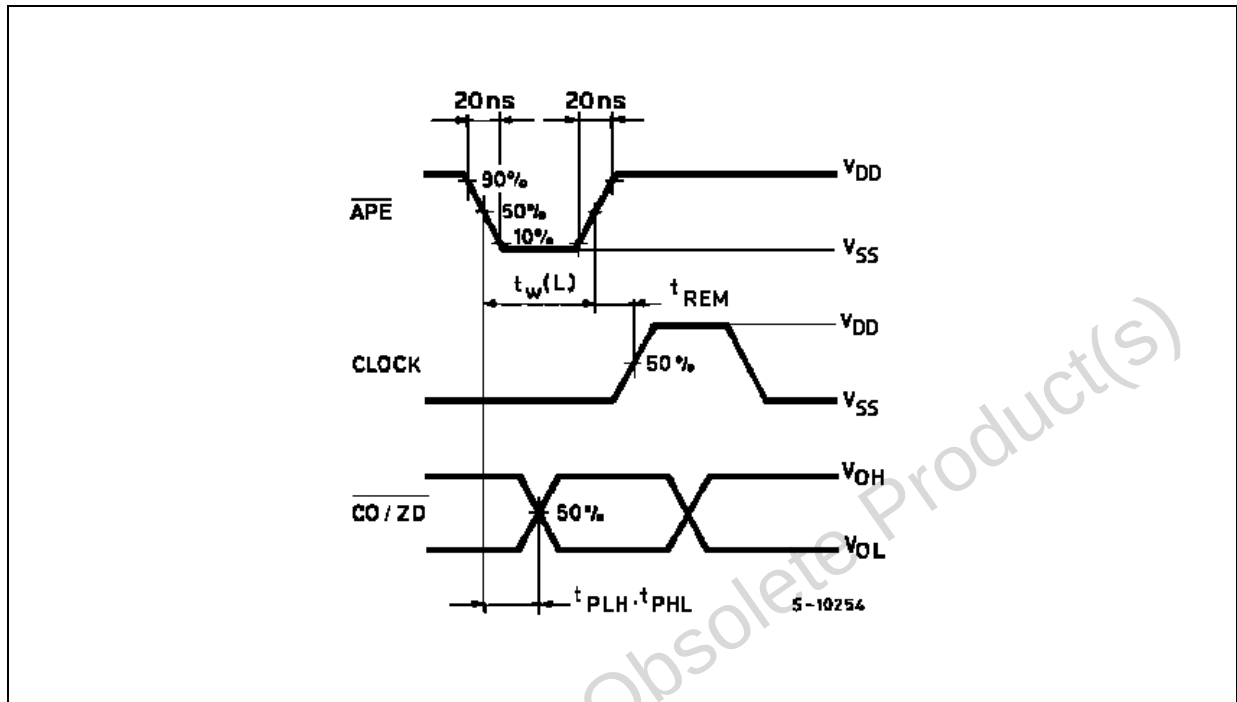
$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)

$R_L = 200\text{K}\Omega$

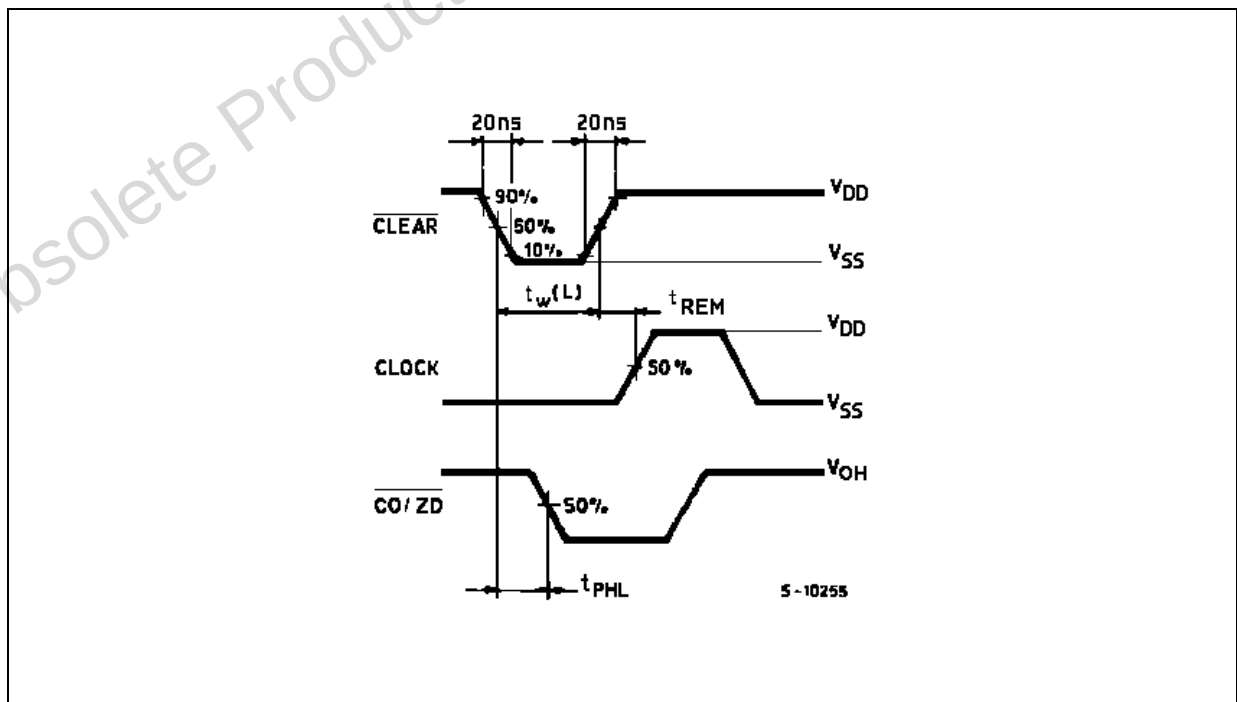
$R_T = Z_{\text{OUT}}$  of pulse generator (typically  $50\Omega$ )

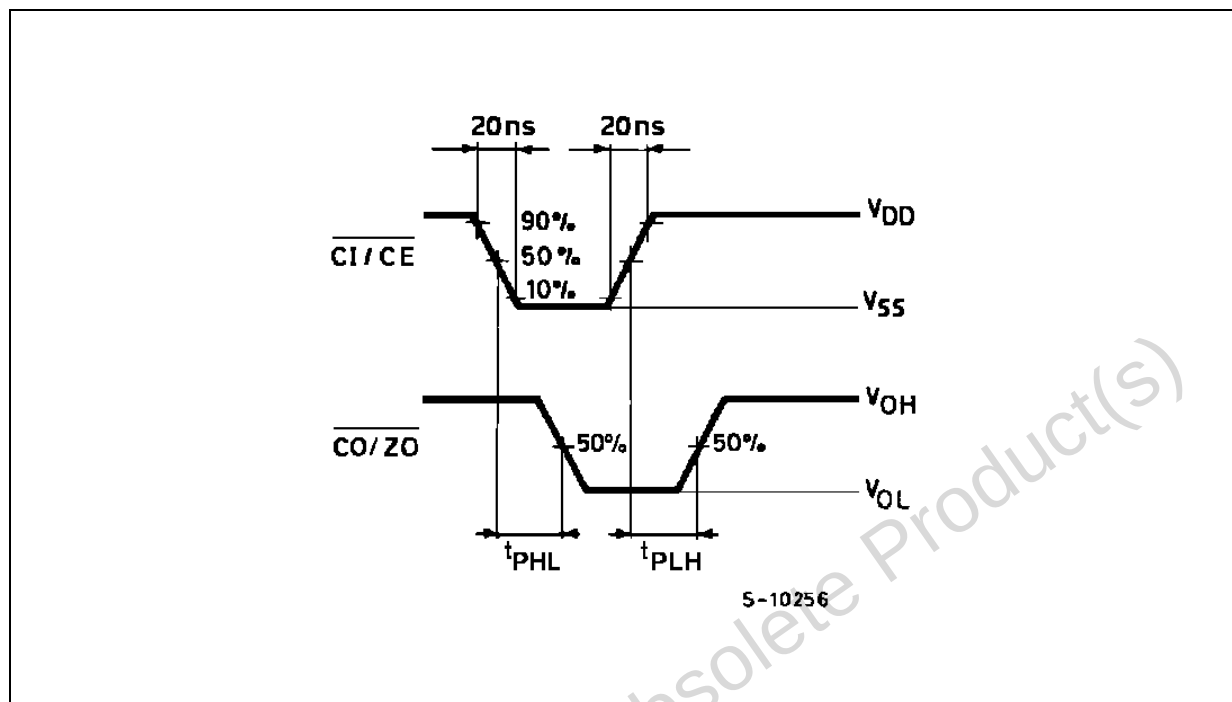
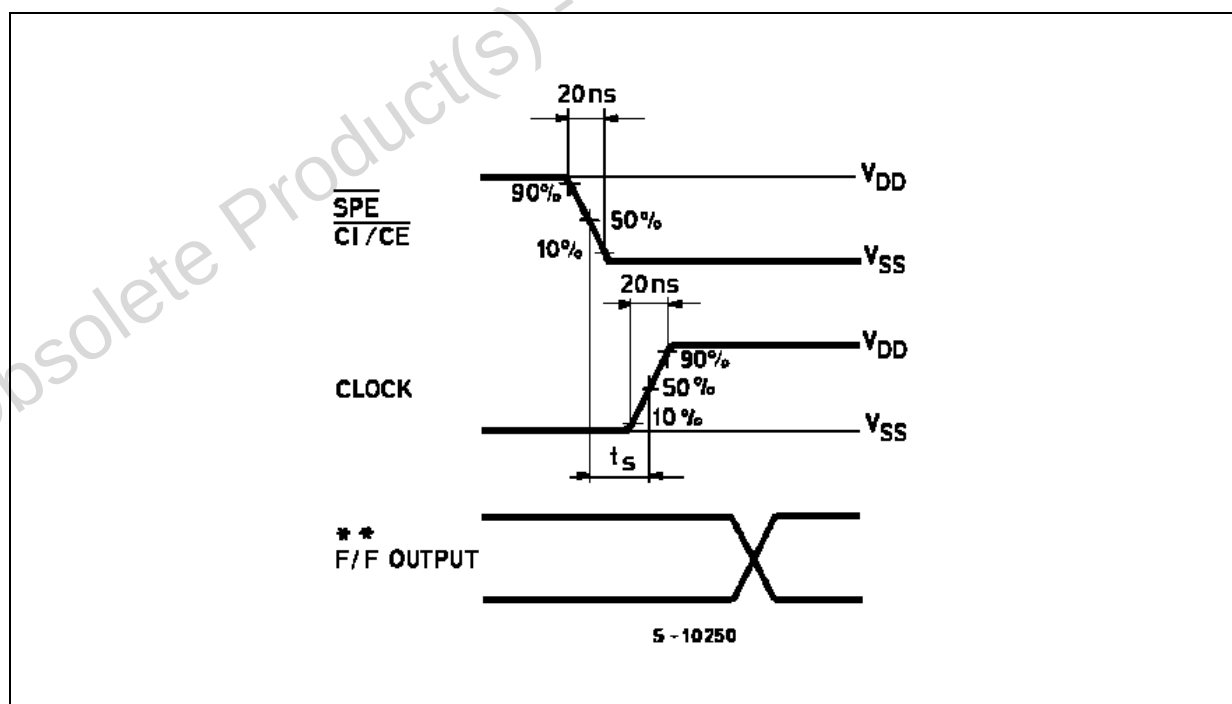
WAVEFORM 1 : PROPAGATION DELAY TIME ( $f=1\text{MHz}$ ; 50% duty cycle)

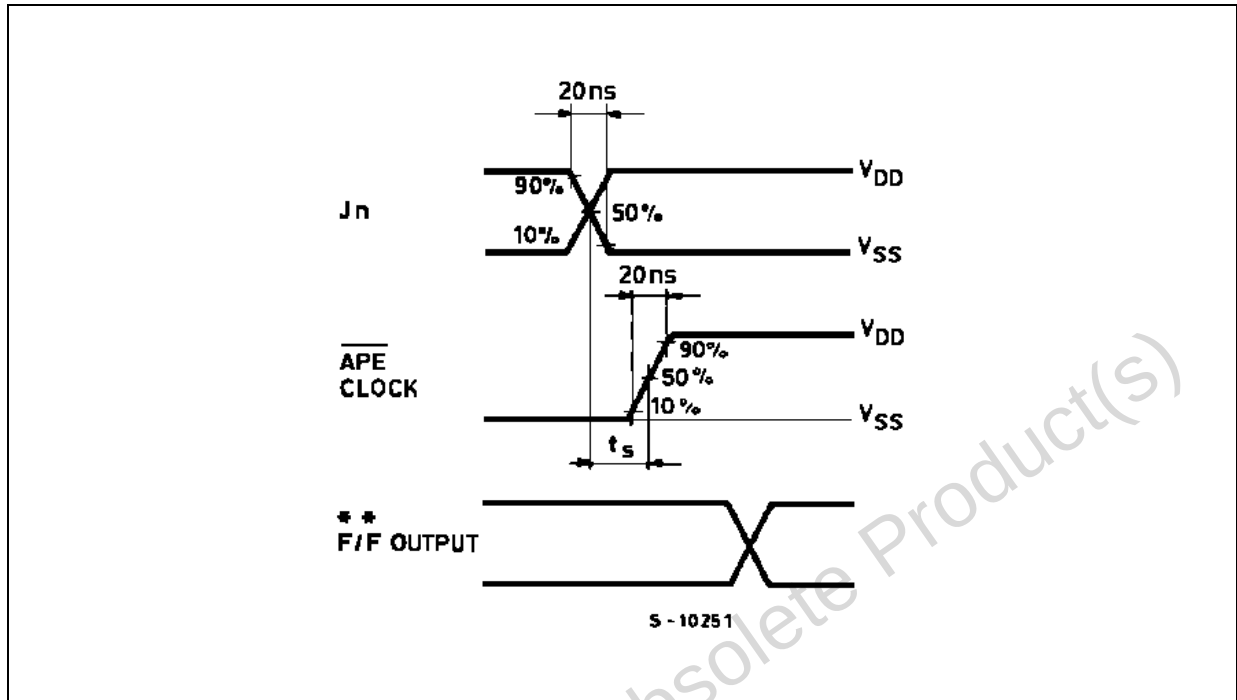
**WAVEFORM 2 : PROPAGATION DELAY, MINIMUM PULSE WIDTH AND REMOVAL TIME** ( $f=1\text{MHz}$ ; 50% duty cycle)



**WAVEFORM 3 : PROPAGATION DELAY, MINIMUM PULSE WIDTH AND REMOVAL TIME** ( $f=1\text{MHz}$ ; 50% duty cycle)

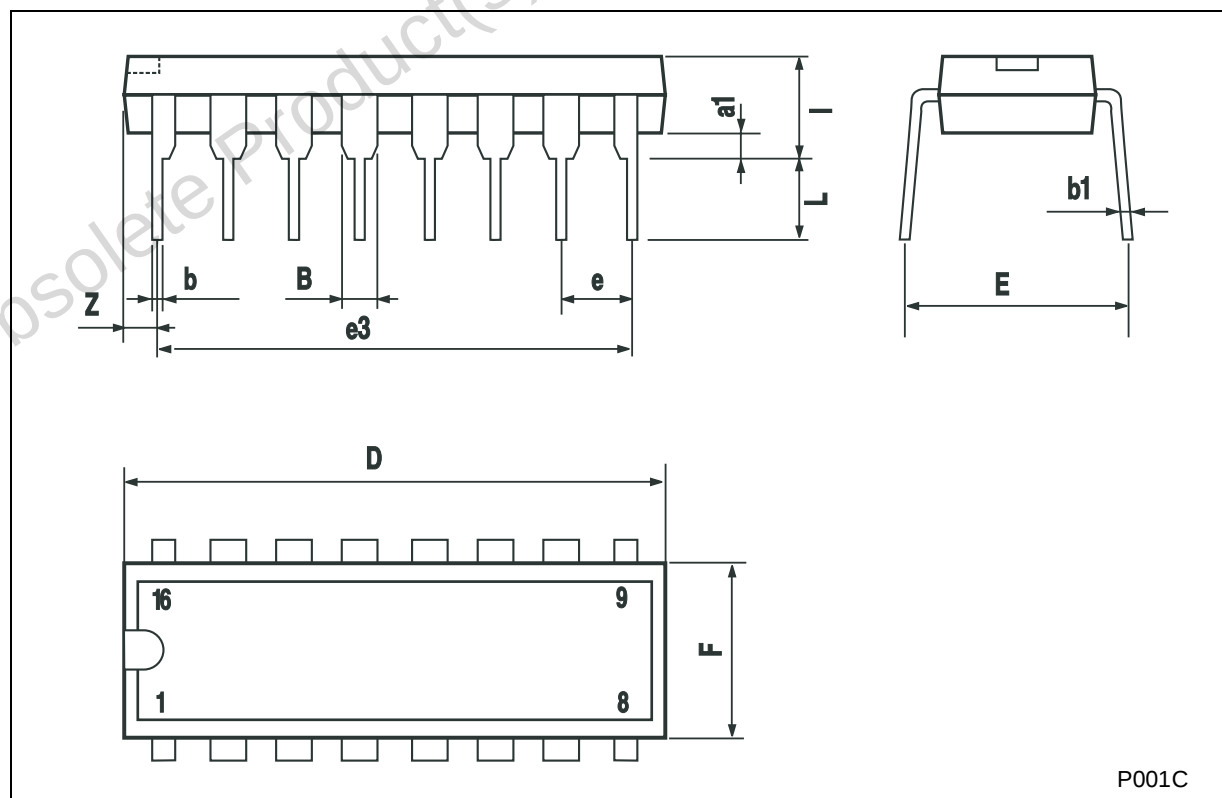


WAVEFORM 4 : PROPAGATION DELAY TIME ( $f=1\text{MHz}$ ; 50% duty cycle)WAVEFORM 5 : MINIMUM SETUP TIME ( $f=1\text{MHz}$ ; 50% duty cycle)

**WAVEFORM 6 : MINIMUM SETUP TIME** ( $f=1\text{MHz}$ ; 50% duty cycle)

## Plastic DIP-16 (0.25) MECHANICAL DATA

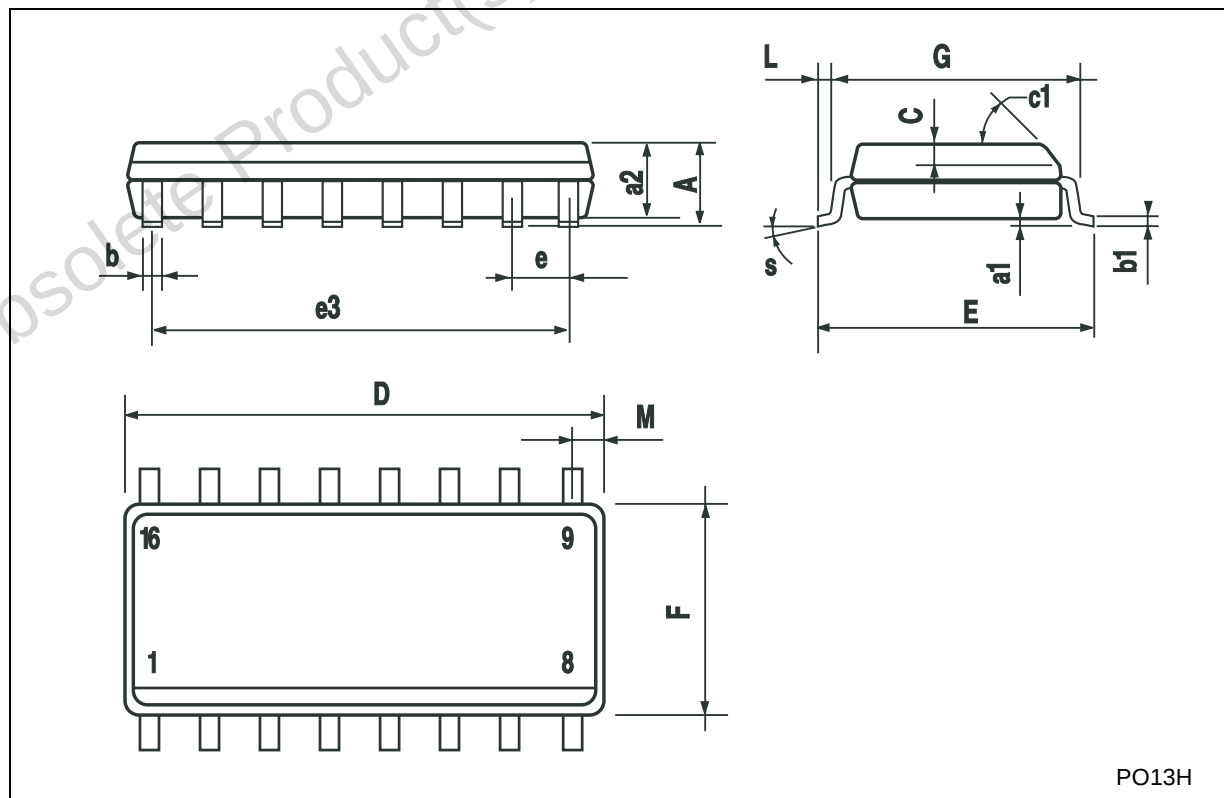
| DIM. | mm.  |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP   | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |      |       | 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.)  |      |      |       |       |       |



Obsolete Product(s) - Obsolete Product(s)

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