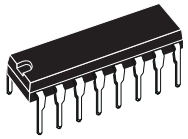
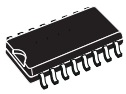
# HCF4040B

## RIPPLE-CARRY BINARY COUNTER/DIVIDERS 12 STAGE

- MEDIUM SPEED OPERATION : $t_{PD}$ = 80ns (TYP.) at $V_{DD}$ = 10V
- FULLY STATIC OPERATION
- COMMON RESET
- BUFFERED INPUTS AND OUTPUTS
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIFIED UP TO 20V
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT LEAKAGE CURRENT $I_I$ = 100nA (MAX) AT $V_{DD}$ = 18V $T_A$ = 25°C
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B " STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"



DIP



SOP

### ORDER CODES

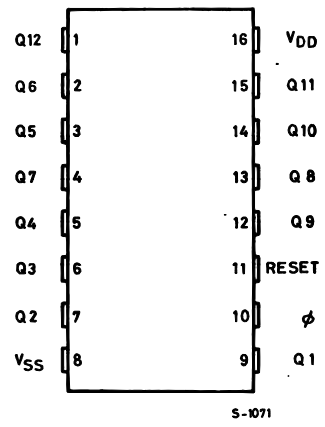
| PACKAGE | TUBE | T & R |
|---|---|---|
| DIP | HCF4040BEY | |
| SOP | HCF4040BM1 | HCF4040M013TR |

### DESCRIPTION

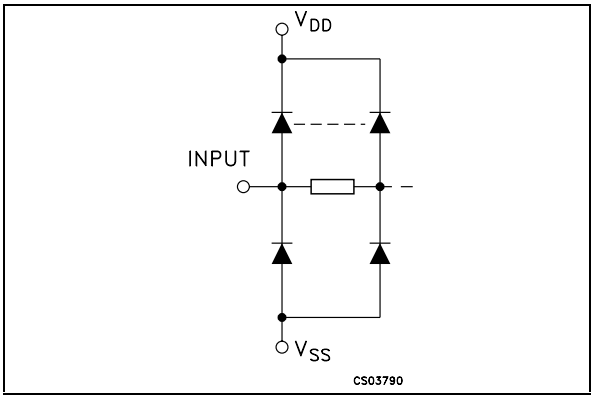
The HCF4040B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages.

The HCF4040B is a ripple carry binary counter. All counter stages are master-slave flip-flops. The state of a counter advances one count on the negative transition of each input pulse; a high level on the RESET line resets the counter to its all zeros stage. Schmitt trigger action on the input pulse line permits unlimited clock rise and fall times.
All inputs and outputs are buffered

### PIN CONNECTION



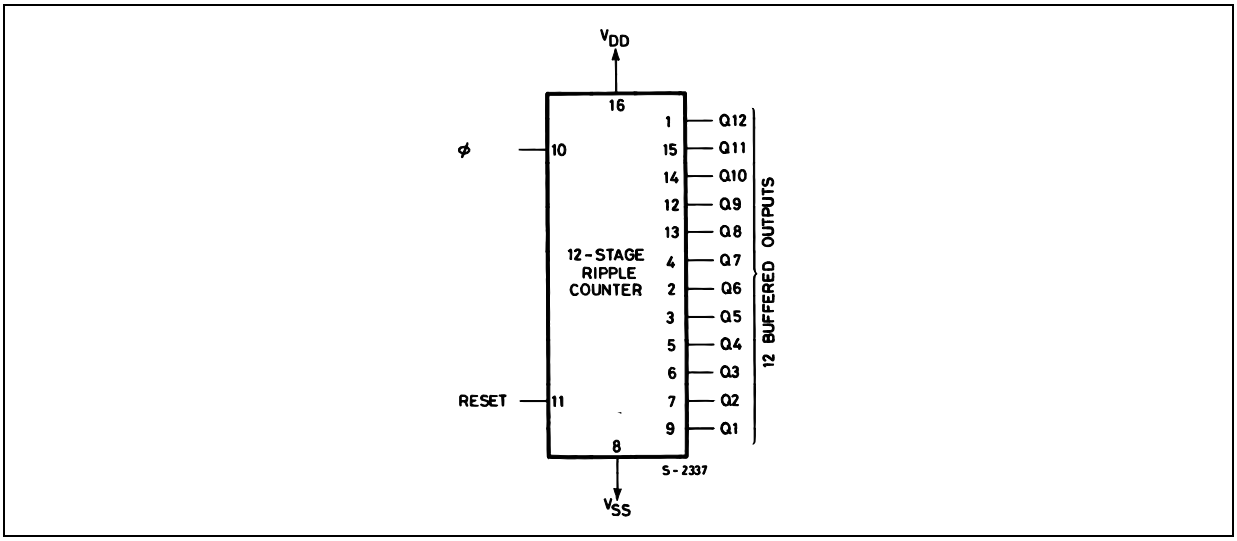
## IINPUT EQUIVALENT CIRCUIT




## PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 9, 7, 5, 4, 6, 13, 12, 14, 15, 1, 2, 3 | Q1 to Q12 | 12 Buffered Outputs |
| 11 | RESET | Reset Input |
| 10 | Φ | Input Pulses |
| 8 | $V_{SS}$ | Negative Supply Voltage |
| 16 | $V_{DD}$ | Positive Supply Voltage |

## FUNCTIONAL DIAGRAM

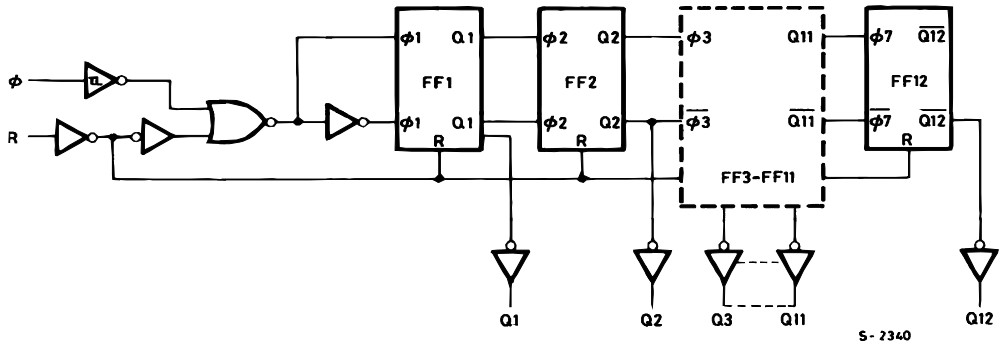



## TRUTH TABLE

| Φ | RESET | OUTPUT STATE |
|---|---|---|
| X | H | ALL OUTPUTS = "L" |
| ⌐ | L | NO CHANGE |
| ¬ | L | ADVANCE TO NEXT STATE |

X : Don't Care

## LOGIC DIAGRAM




## 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 | ± 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_I$ (V) | $V_O$ (V) | $\|I_O\|$ (μA) | $V_{DD}$ (V) | $T_A$ = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $I_L$ | 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 | |
| $V_{OH}$ | 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 | | |
| $V_{OL}$ | 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 | |
| $V_{IH}$ | 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 | | |
| $V_{IL}$ | 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 | |
| $I_{OH}$ | 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 | | |
| $I_{OL}$ | 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 | | |
| $I_I$ | Input Leakage Current | 0/18 | Any Input | | 18 | | $\pm 10^{-5}$ | ±0.1 | | ±1 | | ±1 | μA |
| $C_I$ | Input Capacitance | | Any Input | | | | 5 | 7.5 | | | | | pF |

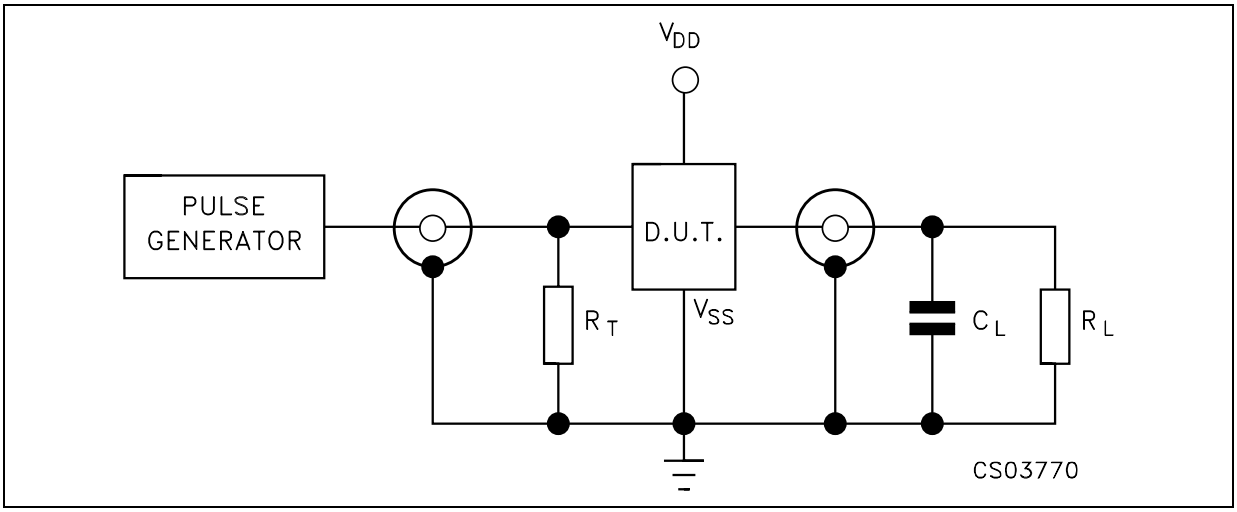
The Noise Margin for both "1" and "0" level is: 1V min. with $V_{DD}$=5V, 2V min. with $V_{DD}$=10V, 2.5V min. with $V_{DD}$=15V

**DYNAMIC ELECTRICAL CHARACTERISTICS** ($T_{amb}$ = 25°C, $C_L$ = 50pF, $R_L$ = 200KΩ, $t_r = t_f$ = 20 ns)

| Symbol | Parameter | Test Condition | | Value (*) | | | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ (V) | | Min. | Typ. | Max. | |
| **INPUT-PULSE OPERATION** | | | | | | | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time (∅ to Q1 Out) | 5 | | | 180 | 360 | ns |
| | | 10 | | | 80 | 160 | |
| | | 15 | | | 65 | 130 | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time (Qn to Qn+1) | 5 | | | 100 | 200 | ns |
| | | 10 | | | 40 | 80 | |
| | | 15 | | | 30 | 60 | |
| $t_{THL}$ $t_{TLH}$ | Transition Time | 5 | | | 100 | 200 | ns |
| | | 10 | | | 50 | 100 | |
| | | 15 | | | 40 | 80 | |
| $t_W$ | Minimum Input Pulse Width | 5 | | | 70 | 140 | ns |
| | | 10 | | | 30 | 60 | |
| | | 15 | | | 20 | 40 | |
| $t_r$ , $t_f$ | Input Pulse Rise and Fall Time | 5 | | unlimited | | | µs |
| | | 10 | | | | | |
| | | 15 | | | | | |
| $f_{max}$ | Maximum Clock Input Frequency | 5 | | 3.5 | 7 | | MHz |
| | | 10 | | 8 | 16 | | |
| | | 15 | | 12 | 24 | | |
| **RESET OPERATION** | | | | | | | |
| $t_{PHL}$ | Propagation Delay Time | 5 | | | 140 | 280 | ns |
| | | 10 | | | 60 | 120 | |
| | | 15 | | | 50 | 100 | |
| $t_W$ | Minimum Reset Pulse Width | 5 | | | 100 | 200 | ns |
| | | 10 | | | 40 | 80 | |
| | | 15 | | | 30 | 60 | |
| $t_{REM}$ | Reset Removal Time | 5 | | | 175 | 350 | ns |
| | | 10 | | | 75 | 150 | |
| | | 15 | | | 50 | 100 | |

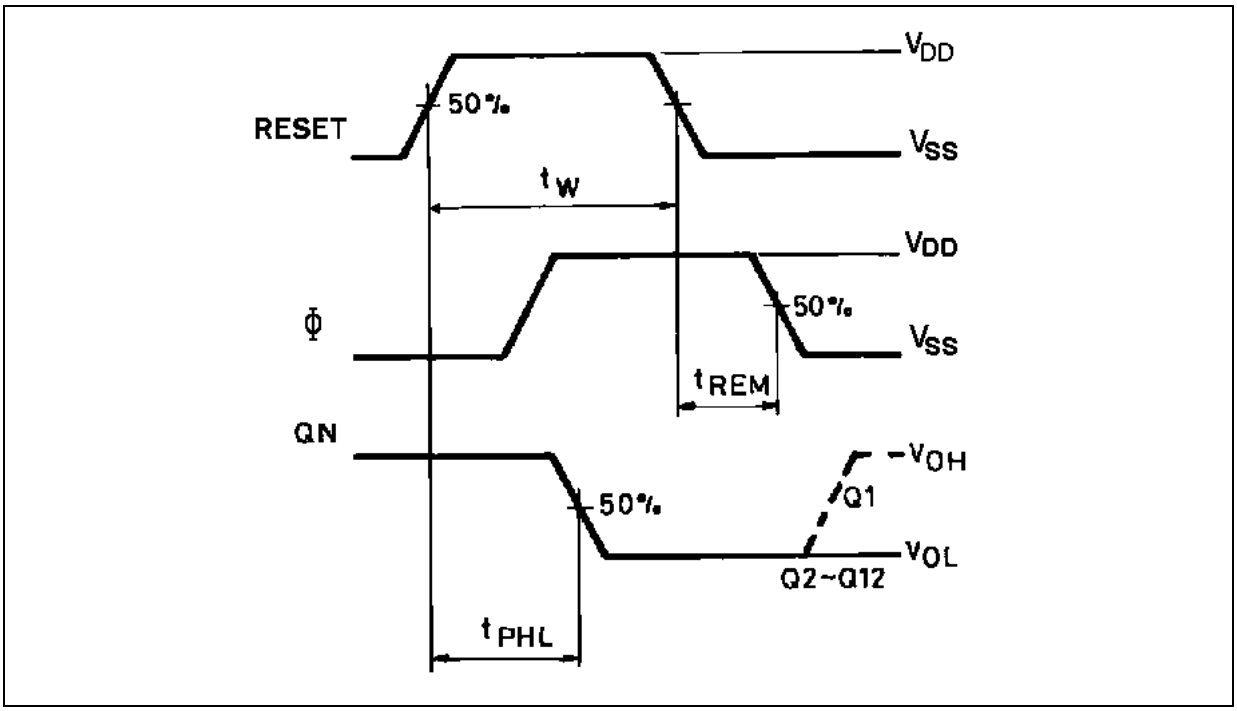
(*) Typical temperature coefficient for all $V_{DD}$ value is 0.3 %/°C.

## TEST CIRCUIT

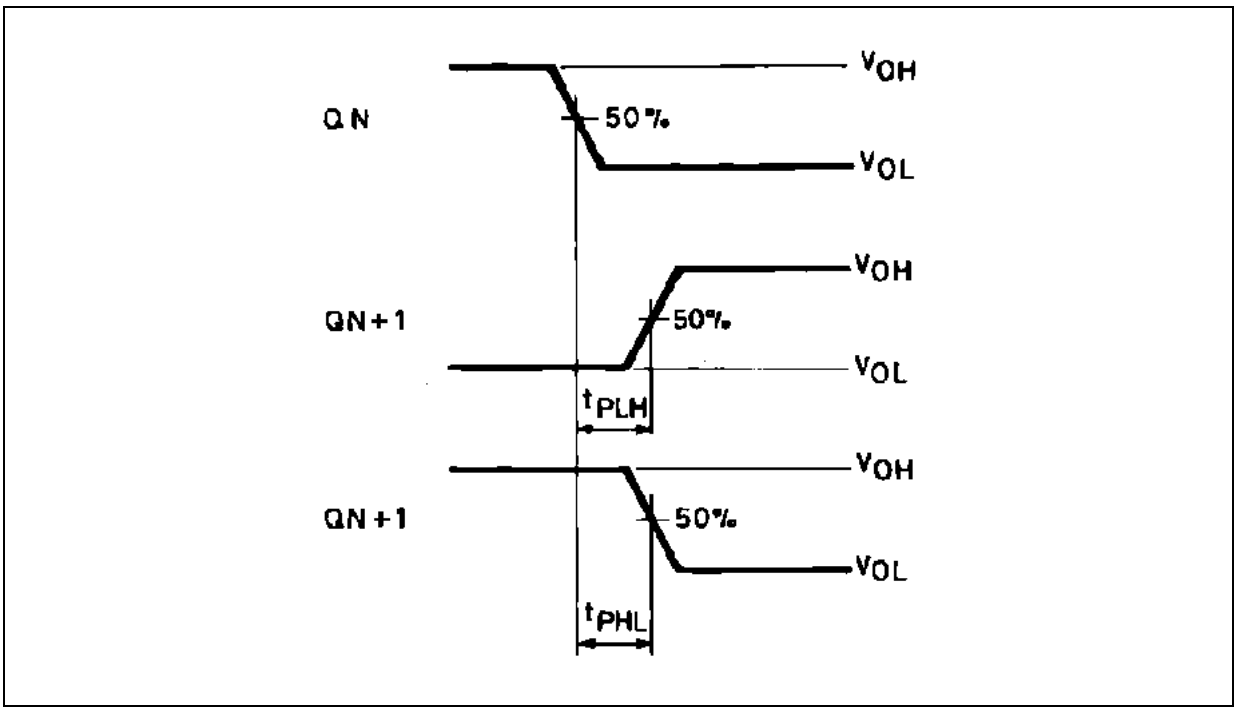



$C_L$ = 50pF or equivalent (includes jig and probe capacitance)
$R_L$ = 200KΩ
$R_T$ = $Z_{OUT}$ of pulse generator (typically 50Ω)

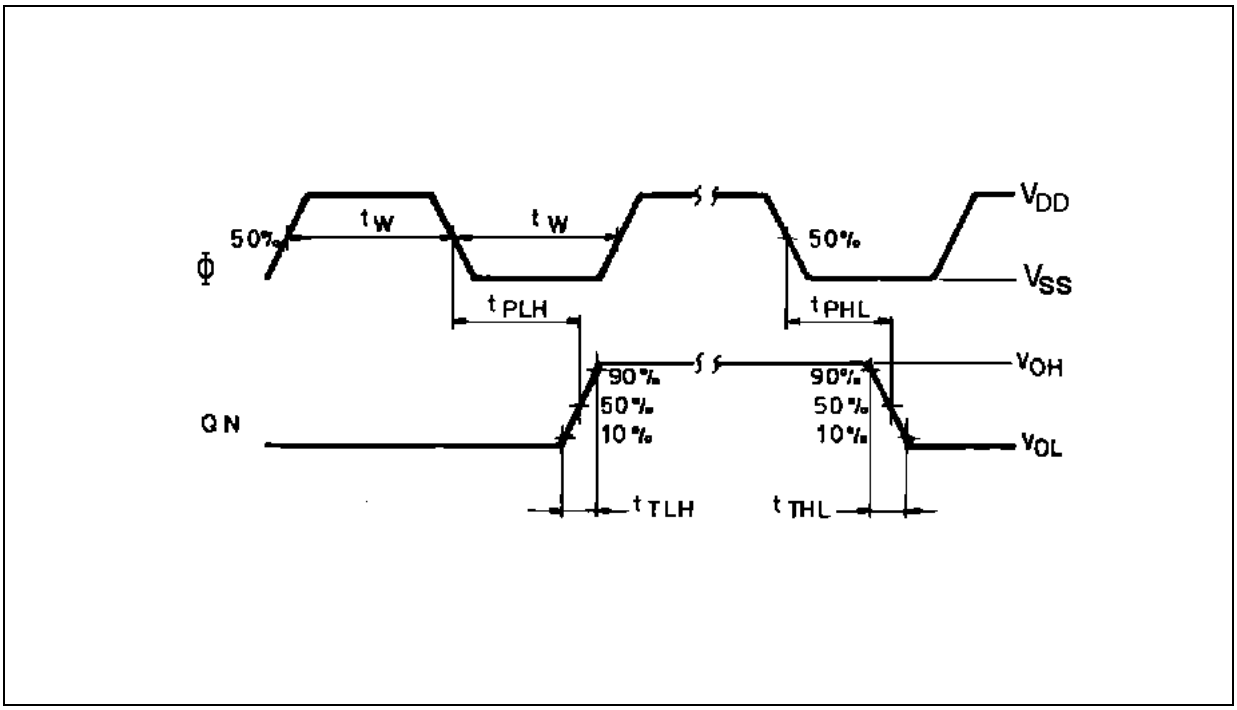
**WAVEFORM 1 : MINIMUM PULSE WIDTH (RESET) AND REMOVAL TIME ( RESET TO Φ)** (f=1MHz; 50% duty cycle)



**WAVEFORM 2 : PROPAGATION DELAY TIME** (f=1MHz; 50% duty cycle)

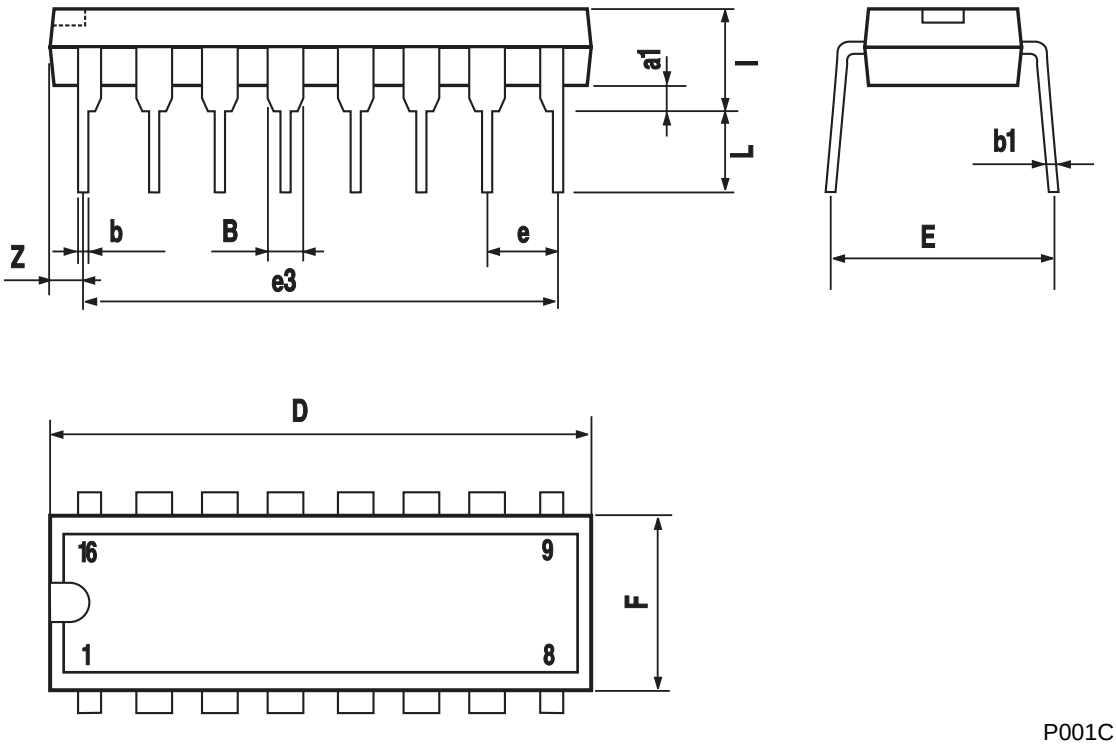



**WAVEFORM 3 : PROPAGATION DELAY TIME, MINIMUM PULSE WIDTH (Φ)** (f=1MHz; 50% duty cycle)



## Plastic DIP-16 (0.25) MECHANICAL DATA

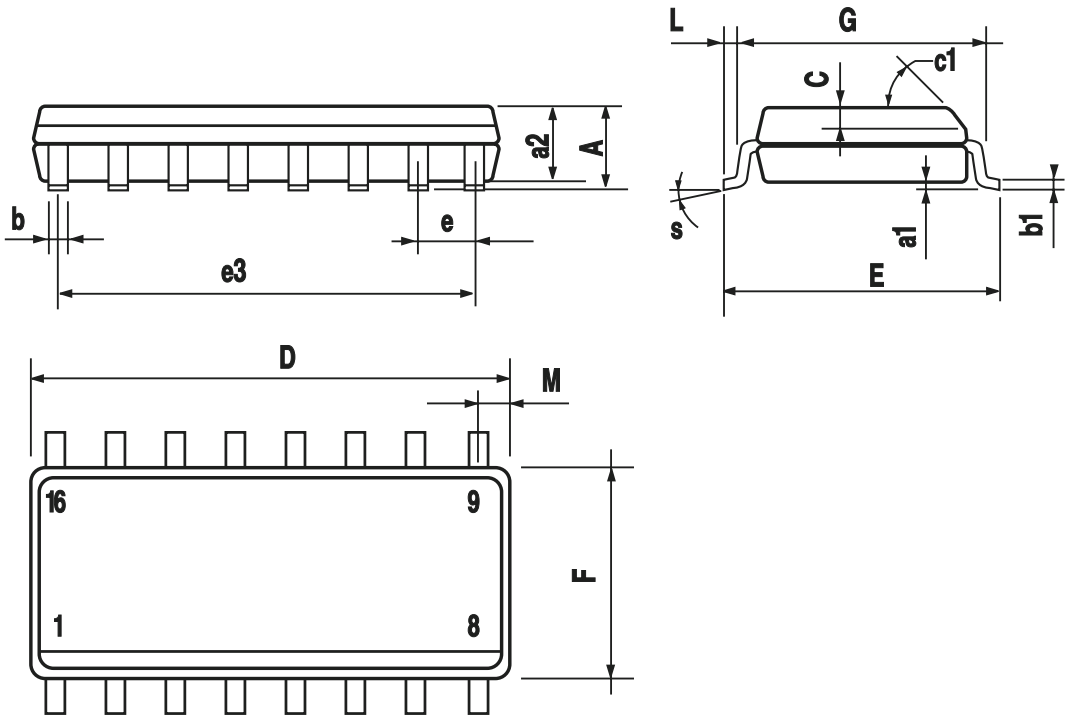
| DIM. | mm. | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 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.) | | | | | |




PO13H