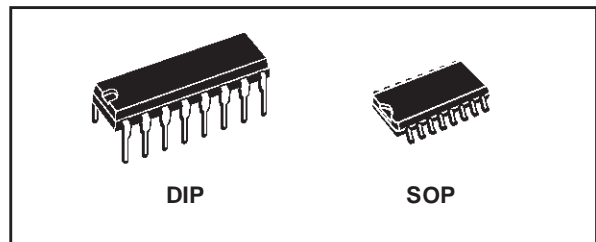# HCF4027B

## DUAL J-K MASTER SLAVE FLIP-FLOP

- SET RESET CAPABILITY
- STATIC FLIP-FLOP OPERATION - RETAINS STATE INDEFINETELY WITH CLOCK LEVEL EITHER "HIGH" OR "LOW"
- MEDIUM-SPEED OPERATION - 16MHz (Typ. clock toggle rate at 10V)
- QUIESCENT CURRENT SPECIFIED UP TO 20V
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 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 | HCF4027BEY | |
| SOP | HCF4027BM1 | HCF4027M013TR |

### DESCRIPTION

HCF4027B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages.
HCF4027B is a single monolithic chip integrated circuit containing two identical complementary-symmetry J-K master-slave flip-flops. Each flip-flop has provisio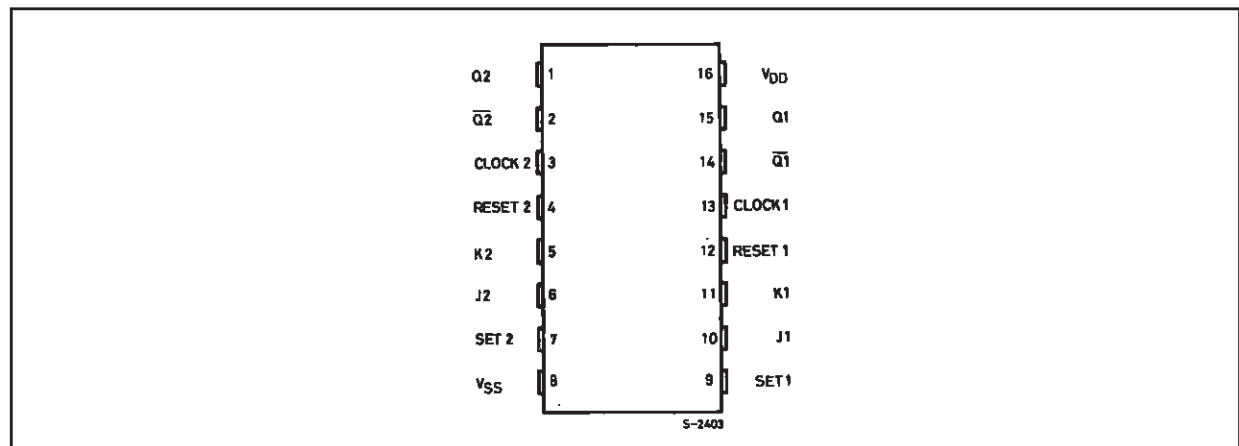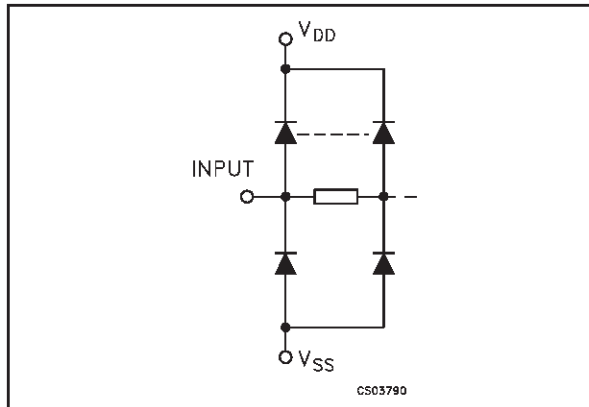ns for individual J, K, Set, Reset, and Clock input signals. Buffered Q and $\overline{Q}$ signals are provided as outputs. This input-output arrangement provides for compatible operation with the HCF4013B dual D type flip-flop.

This device is useful in performing control, register, and toggle functions. Logic levels present at the J and K inputs, along with internal self-steering, control the state of each flip-flop; changes in the flip-flop state are synchronous with the positive-going transition of the clock pulse. Set and Reset functions are independent of the clock and are initiated when a high level signal is present at either the Set or Reset input.

### PIN CONNECTION



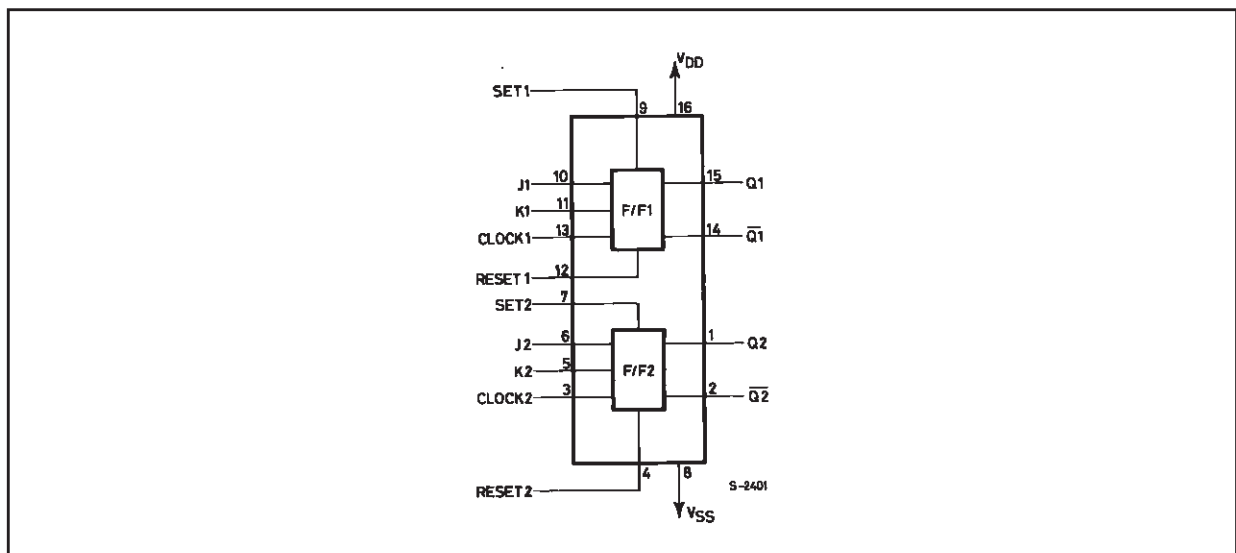| | | |
|---|---|---|
| Q2 | 1 | 16 | $V_{DD}$ |
| $\overline{Q2}$ | 2 | 15 | Q1 |
| CLOCK 2 | 3 | 14 | $\overline{Q1}$ |
| RESET 2 | 4 | 13 | CLOCK 1 |
| K2 | 5 | 12 | RESET 1 |
| J2 | 6 | 11 | K1 |
| SET 2 | 7 | 10 | J1 |
| $V_{SS}$ | 8 | 9 | SET 1 |

S-2403

## INPUT EQUIVALENT CIRCUIT



## PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|--------|--------|-------------------|
| 6, 5 | J2, K2 | Inputs |
| 10,11 | J1, K1 | inputs |
| 13, 3 | CLOCK1, CLOCK2 | Clock Inputs |
| 12, 4 | RESET1, RESET2 | Reset Inputs |
| 9, 7 | SET1, SET2 | Set Inputs |
| 1, 2 | Q2, $\overline{Q2}$ | Outputs |
| 15, 14 | Q1, $\overline{Q1}$ | Outputs |
| 8 | $V_{SS}$ | Negative Supply Voltage |
| 16 | $V_{DD}$ | Positive Supply Voltage |

## FUNCTIONAL DIAGRAM



## TRUTH TABLE

| PRESENT STATE | | | | | CLOCK* | NEXT STATE | | |
|---|---|---|---|---|---|---|---|---|
| Inputs | | | | Output | | Outputs | | |
| J | K | S | R | Q | | Q | $\overline{Q}$ | |
| H | X | L | L | L | ⌐ | H | L | |
| X | L | L | L | H | ⌐ | H | L | |
| L | X | L | L | L | ⌐ | L | H | |
| X | H | L | L | H | ⌐ | L | H | |
| X | X | L | L | X | ⌐ | | | NO CHANGE |
| X | X | H | L | X | X | H | L | |
| X | X | L | H | X | X | L | H | |
| X | X | H | H | X | X | H | H | |

X : Don"t Care
* : Level Change

## 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 | | 0.02 | 1 | | 30 | | 30 | µA |
| | | 0/10 | | | 10 | | 0.02 | 2 | | 60 | | 60 | |
| | | 0/15 | | | 15 | | 0.02 | 4 | | 120 | | 120 | |
| | | 0/20 | | | 20 | | 0.04 | 20 | | 600 | | 600 | |
| $V_{OH}$ | 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 | | -1.15 | | -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 | | $\pm10^{-5}$ | $\pm0.1$ | | $\pm1$ | | $\pm1$ | 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

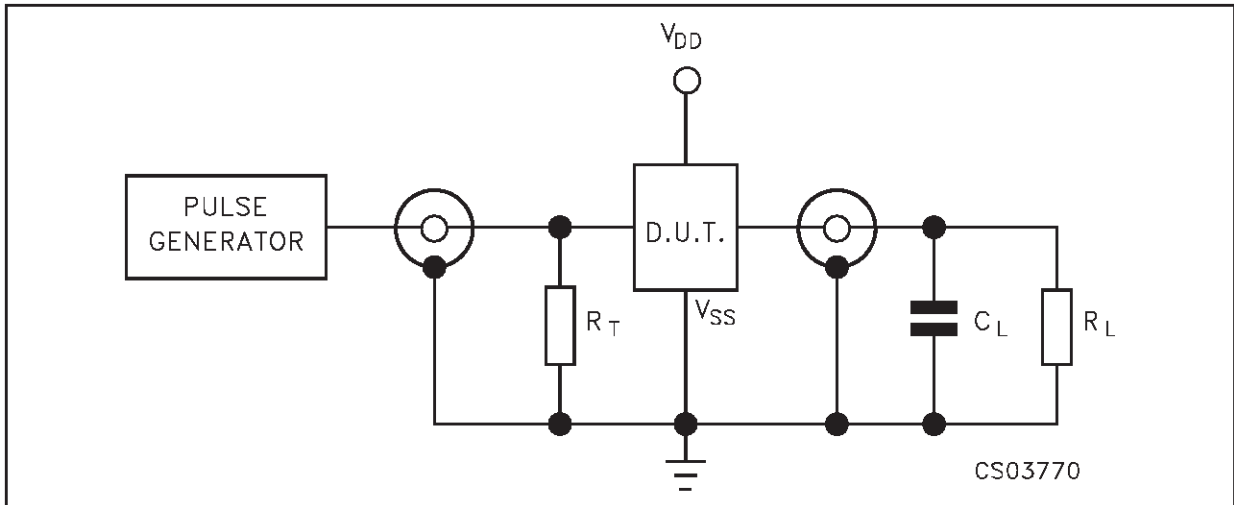## DYNAMIC ELECTRICAL CHARACTERISTICS ($T_{amb}$ = 25°C, $C_L$ = 50pF, $R_L$ = 200KΩ, $t_r = t_f$ = 20 ns)

| Symbol | Parameter | Test Condition | | Value (*) | | | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ (V) | | Min. | Typ. | Max. | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time(Clock to Q or $\overline{Q}$ Outputs) | 5 | | | 150 | 300 | ns |
| | | 10 | | | 65 | 130 | |
| | | 15 | | | 45 | 90 | |
| $t_{PLH}$ | Propagation Delay Time (Set to Q or Reset to $\overline{Q}$) | 5 | | | 150 | 300 | ns |
| | | 10 | | | 65 | 130 | |
| | | 15 | | | 45 | 90 | |
| $t_{PHL}$ | Propagation Delay Time (Set to $\overline{Q}$ or Reset to Q) | 5 | | | 200 | 400 | ns |
| | | 10 | | | 85 | 170 | |
| | | 15 | | | 60 | 120 | |
| $t_{TLH}$ $t_{THL}$ | Transition Time | 5 | | | 100 | 200 | ns |
| | | 10 | | | 50 | 100 | |
| | | 15 | | | 40 | 80 | |
| $t_W$ | Pulse Width (Clock) | 5 | | 140 | 70 | | ns |
| | | 10 | | 60 | 30 | | |
| | | 15 | | 40 | 20 | | |
| $t_W$ | Pulse Width (Set or Reset) | 5 | | 180 | 90 | | ns |
| | | 10 | | 80 | 40 | | |
| | | 15 | | 50 | 25 | | |
| $t_r$, $t_f$ | Clock input Rise or Fall Time | 5 | | | | 15 | µs |
| | | 10 | | | | 4 | |
| | | 15 | | | | 1 | |
| $t_{setup}$ | Setup Time (DATA) | 5 | | 200 | 100 | | ns |
| | | 10 | | 75 | 35 | | |
| | | 15 | | 50 | 25 | | |
| $f_{MAX}$ | Maximum Clock Input Frequency [1] (toggle mode) | 5 | | 3.5 | 7 | | MHz |
| | | 10 | | 8 | 16 | | |
| | | 15 | | 12 | 24 | | |

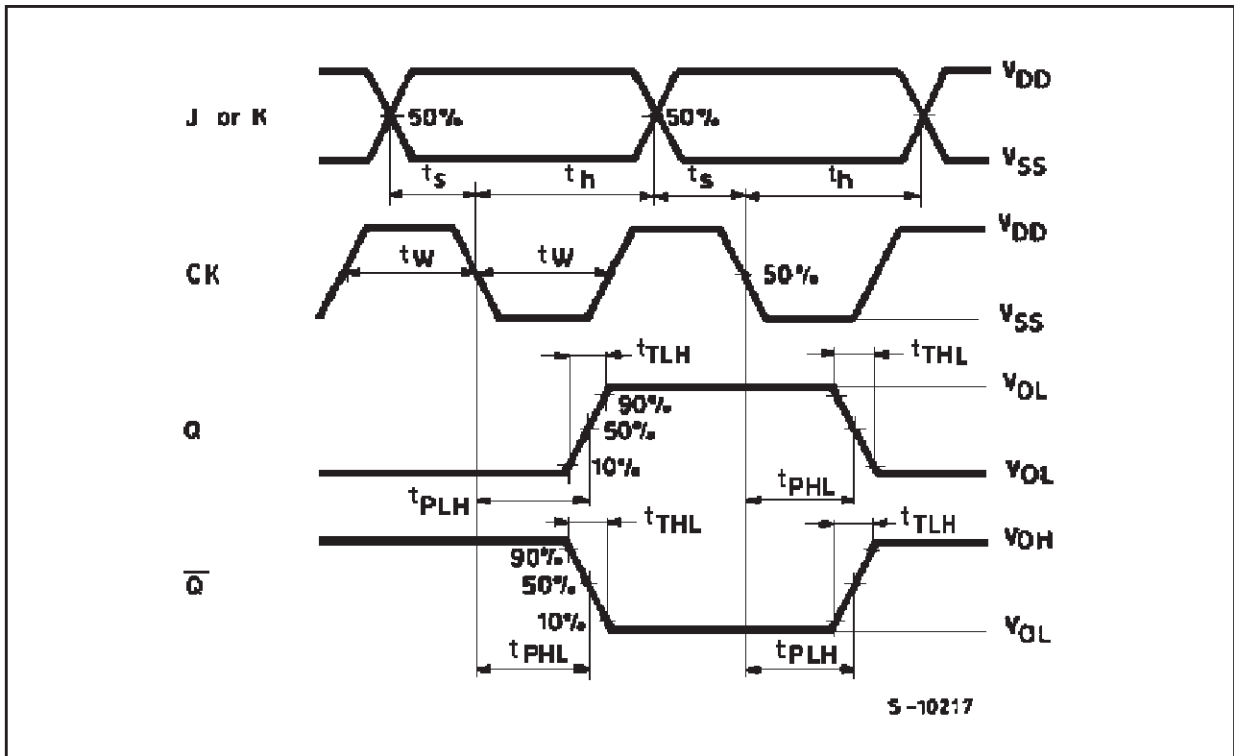(*) Typical temperature coefficient for all $V_{DD}$ value is 0.3 %/°C.
(1) Input $t_r$, $t_f$ = 5ns

## TEST CIRCUIT
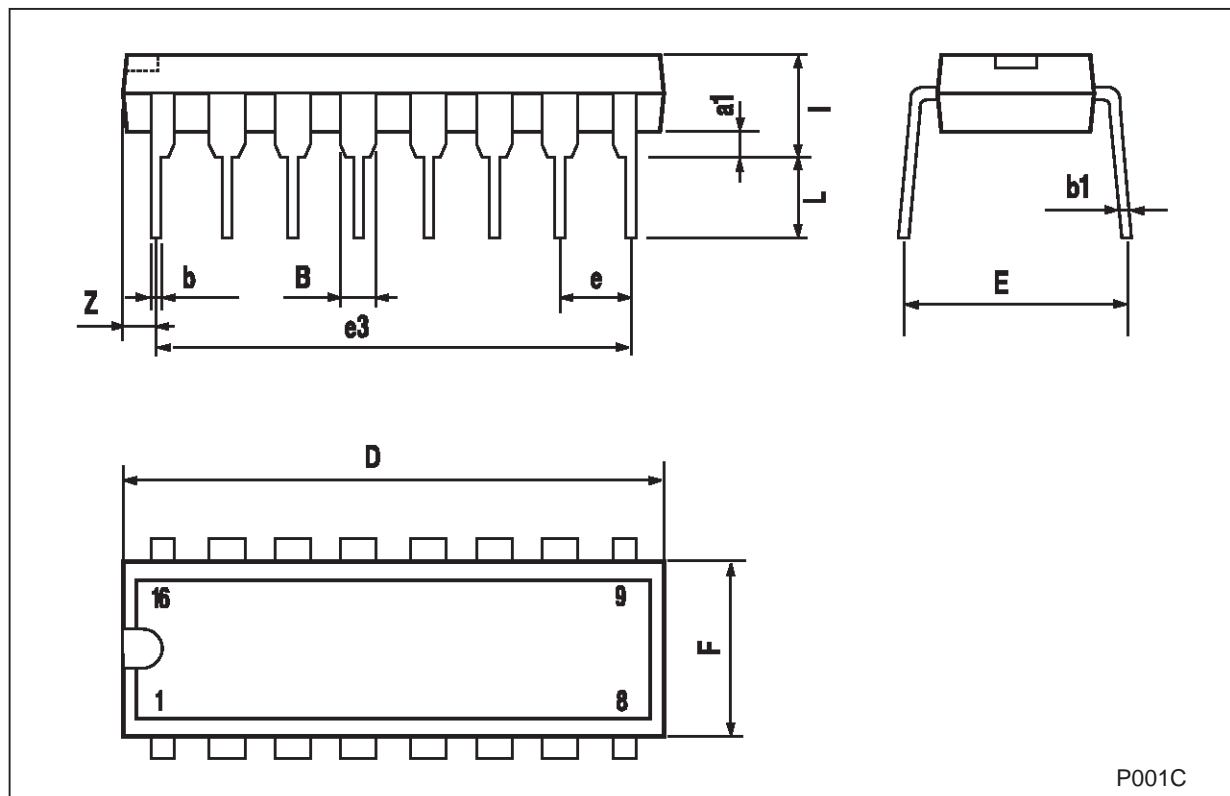


$C_L$ = 50pF or equivalent (includes jig and probe capacitance)

$R_L$ = 200K$\Omega$

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

## WAVEFORM : PROPAGATION DELAY TIMES, MINIMUM PULSE WIDTH (CK), SETUP AND HOLD TIME (J or K to CK) (f=1MHz; 50% duty cycle)

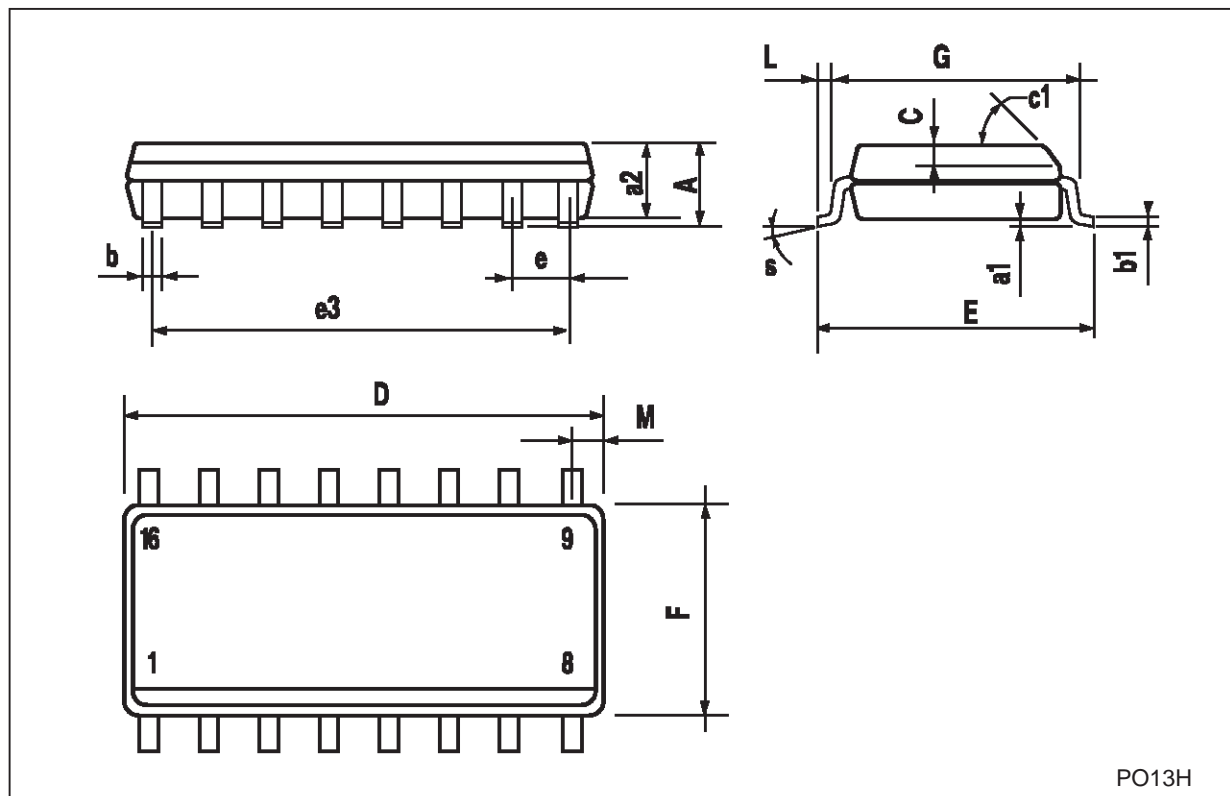## Plastic DIP-16 (0.25) MECHANICAL DATA

| 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