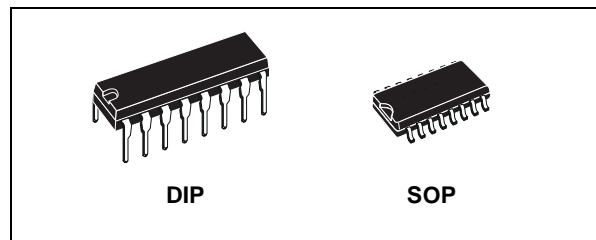




# HCF4021B

## ASYNCHRONOUS PARALLEL IN OR SYNCHRONOUS SERIAL IN/SERIAL OUT 8 - STAGE STATIC SHIFT REGISTER

- MEDIUM SPEED OPERATION : 12 MHz (Typ.) CLOCK RATE AT  $V_{DD} - V_{SS} = 10V$
- FULLY STATIC OPERATION
- 8 MASTER-SLAVE FLIP-FLOPS PLUS OUTPUT BUFFERING AND CONTROL GATING
- QUIESCENT CURRENT SPECIFIED UP TO 20V
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT LEAKAGE CURRENT  
 $I_l = 100nA$  (MAX) AT  $V_{DD} = 18V$   $T_A = 25^\circ C$
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B " STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"



### ORDER CODES

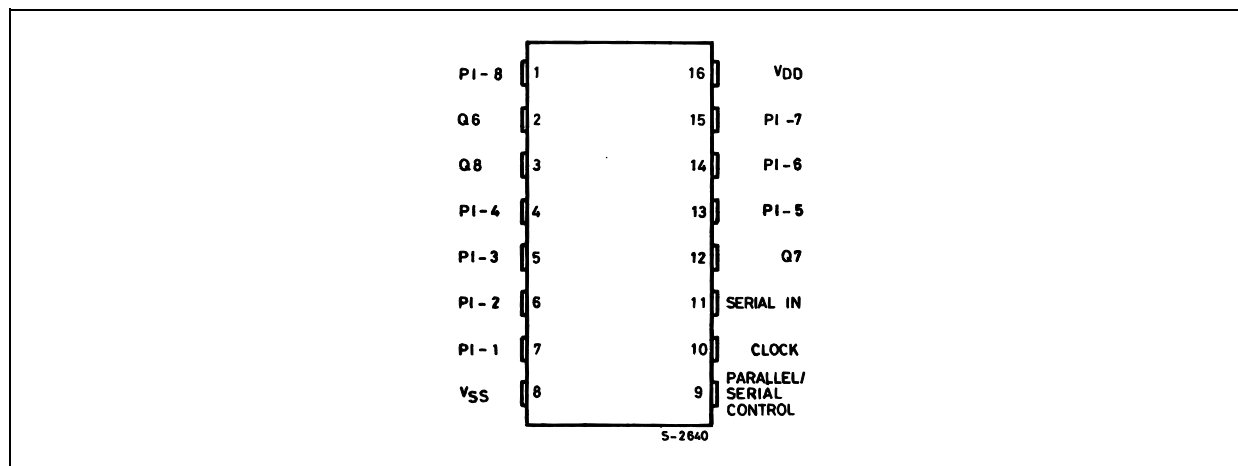
| PACKAGE | TUBE       | T & R         |
|---------|------------|---------------|
| DIP     | HCF4021BEY |               |
| SOP     | HCF4021BM1 | HCF4021M013TR |

### DESCRIPTION

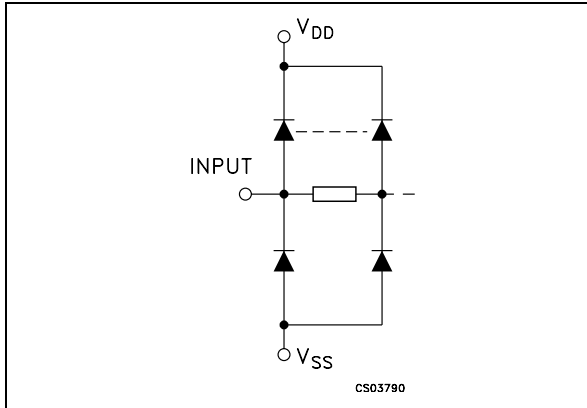
The HCF4021B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages. This device is an 8-stage parallel or serial input/serial output register having common CLOCK and PARALLEL/SERIAL CONTROL inputs, a single SERIAL data input, and individual parallel "JAM" inputs to each register stage. Each register stage is a D-type, master-slave flip-flop in addition to an output from stage 8, "Q" outputs are also available from stages 6 and 7. Serial entry is synchronous with the clock but parallel entry is asynchronous.

In this device, entry is controlled by the PARALLEL/SERIAL CONTROL input. When the PARALLEL/SERIAL CONTROL input is low, data is serially shifted into the 8-stage register synchronously with the positive transition of the clock line. When the PARALLEL/SERIAL CONTROL input is high, data is jammed into the 8-stage register via the parallel input lines and synchronous with the positive transition of the clock line, the CLOCK input of the internal stage is "forced" when asynchronous parallel entry is made. Register expansion using multiple package is permitted.

### PIN CONNECTION



IINPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

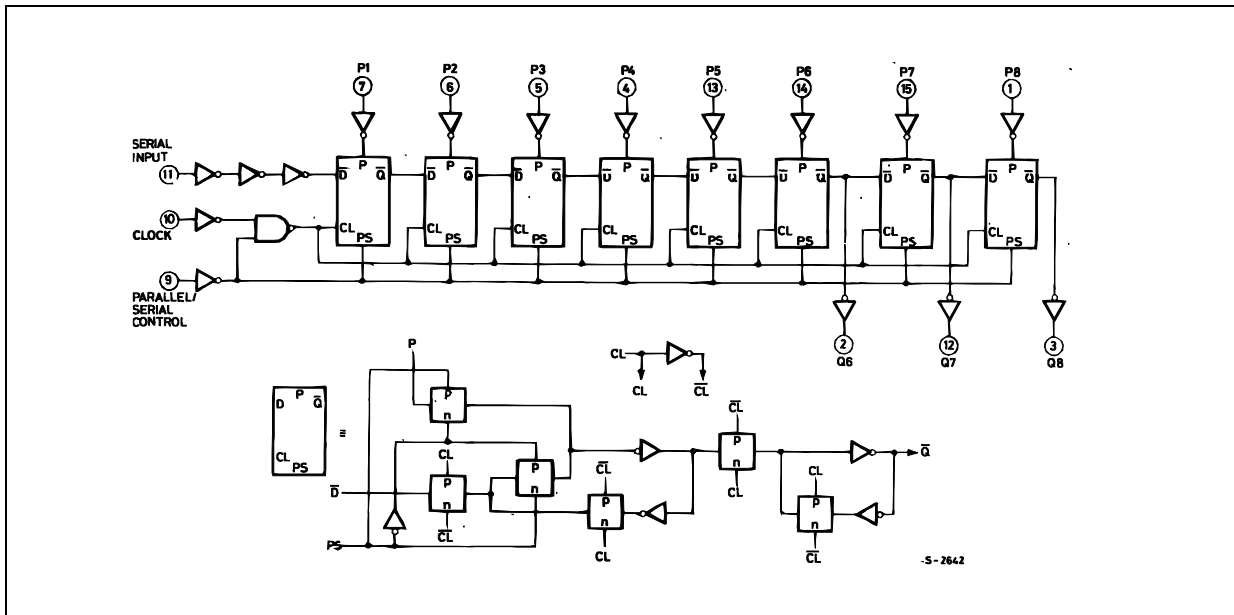
| PIN No                    | SYMBOL                  | NAME AND FUNCTION             |
|---------------------------|-------------------------|-------------------------------|
| 7, 6, 5, 4, 13, 14, 15, 1 | PI1 to PI8              | Parallel Input                |
| 11                        | SERIAL IN               | Serial Input                  |
| 9                         | PARALLEL/SERIAL CONTROL | Parallel/Serial Input Control |
| 10                        | CLOCK                   | Clock Input                   |
| 2, 3, 12                  | Q6, Q7, Q8              | Buffered Outputs              |
| 8                         | V <sub>SS</sub>         | Negative Supply Voltage       |
| 16                        | V <sub>DD</sub>         | Positive Supply Voltage       |

TRUTH TABLE

| CLOCK | SERIAL INPUT | PARALLEL/SERIAL CONTROL | PI - 1 | PI - n | Q <sub>1</sub> (INTERNAL) | Q <sub>n</sub>     |
|-------|--------------|-------------------------|--------|--------|---------------------------|--------------------|
| X     | X            | 1                       | 0      | 0      | 0                         | 0                  |
| X     | X            | 1                       | 0      | 1      | 0                         | 1                  |
| X     | X            | 1                       | 1      | 0      | 1                         | 0                  |
| X     | X            | 1                       | 1      | 1      | 1                         | 1                  |
|       | 0            | 0                       | X      | X      | 0                         | Q <sub>n</sub> - 1 |
|       | 1            | 0                       | X      | X      | 1                         | Q <sub>n</sub> - 1 |
|       | X            | X                       | X      | X      | Q <sub>1</sub>            | Q <sub>n</sub>     |

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                        | $\pm 10$               | 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>( $\mu$ A) | 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     | $\mu$ A |
|                 |                           | 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                     |                       | $\pm 10^{-5}$ | $\pm 0.1$ |             | $\pm 1$ |              | $\pm 1$ | $\mu$ A |
| 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

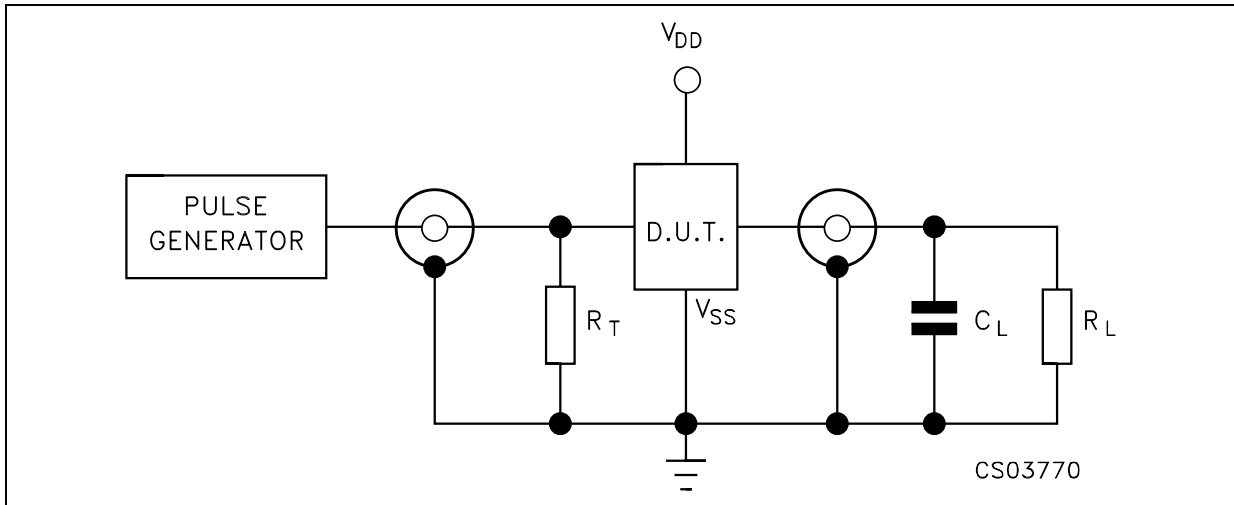
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{K}\Omega$ ,  $t_r = t_f = 20\text{ ns}$ )

| Symbol                   | Parameter   | Test Condition |  | Value (*) |      |      | Unit          |
|--------------------------|---|----------------|--|-----------|------|------|---------------|
|                          |   | $V_{DD}$ (V)   |  | Min.      | Typ. | Max. |               |
| <b>CLOCKED OPERATION</b> |   |                |  |           |      |      |               |
| $t_{PLH}$ $t_{PHL}$      | Propagation Delay Time                                      | 5              |  |           | 160  | 320  | ns            |
|                          |   | 10             |  |           | 80   | 160  |               |
|                          |   | 15             |  |           | 60   | 120  |               |
| $t_{THL}$ $t_{TLH}$      | Transition Time   | 5              |  |           | 100  | 200  | ns            |
|                          |   | 10             |  |           | 50   | 100  |               |
|                          |   | 15             |  |           | 40   | 80   |               |
| $f_{CL}^{(1)}$           | Maximum Clock Input Frequency                               | 5              |  | 3         | 6    |      | MHz           |
|                          |   | 10             |  | 6         | 12   |      |               |
|                          |   | 15             |  | 8.5       | 17   |      |               |
| $t_W$                    | Clock Pulse Width   | 5              |  | 180       | 90   |      | ns            |
|                          |   | 10             |  | 80        | 40   |      |               |
|                          |   | 15             |  | 50        | 25   |      |               |
| $t_r, t_f$               | Clock Input Rise or Fall Time                               | 5              |  |           |      | 15   | $\mu\text{s}$ |
|                          |   | 10             |  |           |      | 15   |               |
|                          |   | 15             |  |           |      | 15   |               |
| $t_{setup}$              | Setup Time, serial Input (ref to CL)                        | 5              |  | 120       | 60   |      | ns            |
|                          |   | 10             |  | 80        | 40   |      |               |
|                          |   | 15             |  | 60        | 30   |      |               |
| $t_{setup}$              | Setup Time, Parallel Inputs (ref to P/S)                    | 5              |  | 50        | 25   |      | ns            |
|                          |   | 10             |  | 30        | 15   |      |               |
|                          |   | 15             |  | 20        | 10   |      |               |
| $t_{hold}$               | Hold Time, serial in, parallel in, parallel /serial control | 5              |  | 0         |      |      | ns            |
|                          |   | 10             |  | 0         |      |      |               |
|                          |   | 15             |  | 0         |      |      |               |
| $t_{WH}$                 | P/S Pulse Widht   | 5              |  | 160       | 80   |      | ns            |
|                          |   | 10             |  | 80        | 40   |      |               |
|                          |   | 15             |  | 50        | 25   |      |               |
| $t_{rem}$                | P/S Removal Time (ref to CL)                                | 5              |  | 280       | 140  |      | ns            |
|                          |   | 10             |  | 140       | 70   |      |               |
|                          |   | 15             |  | 100       | 50   |      |               |

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

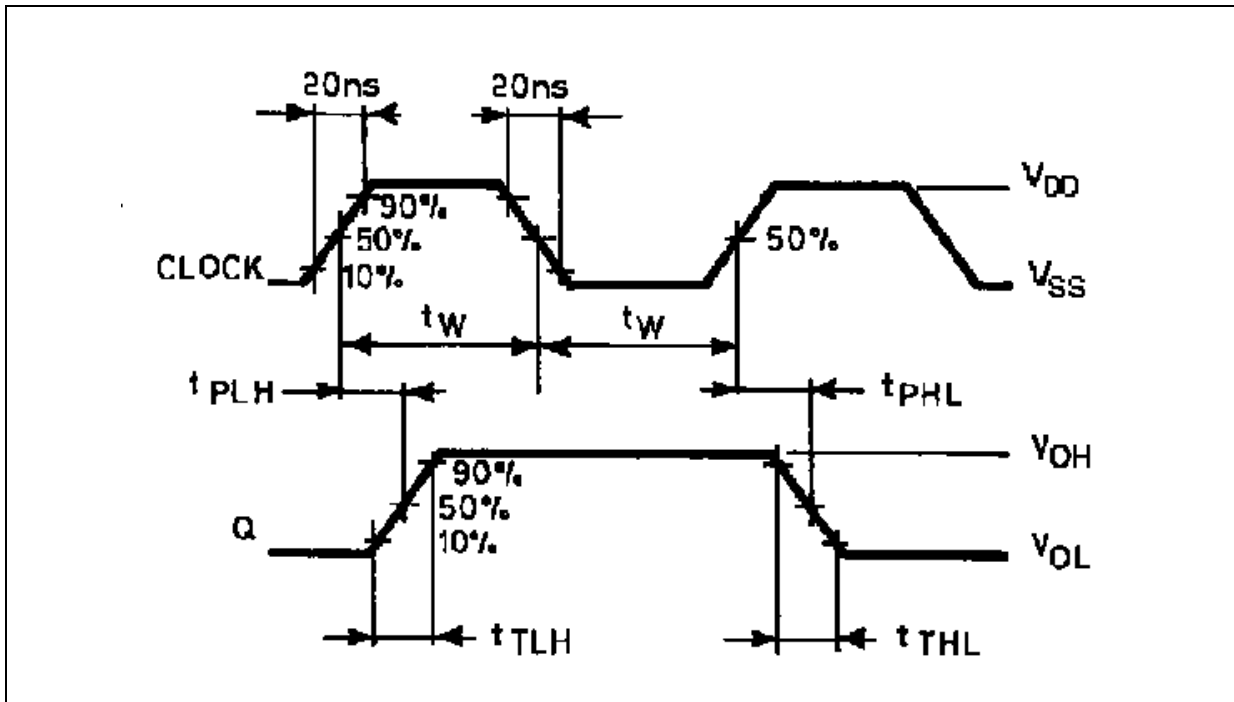
(1) If more than one unit is cascaded  $t_{rCL}$  should be made less than or equal to the sum of the transition time and the fixed propagation delay of the output of the driving stage of the estimated capacitive load.

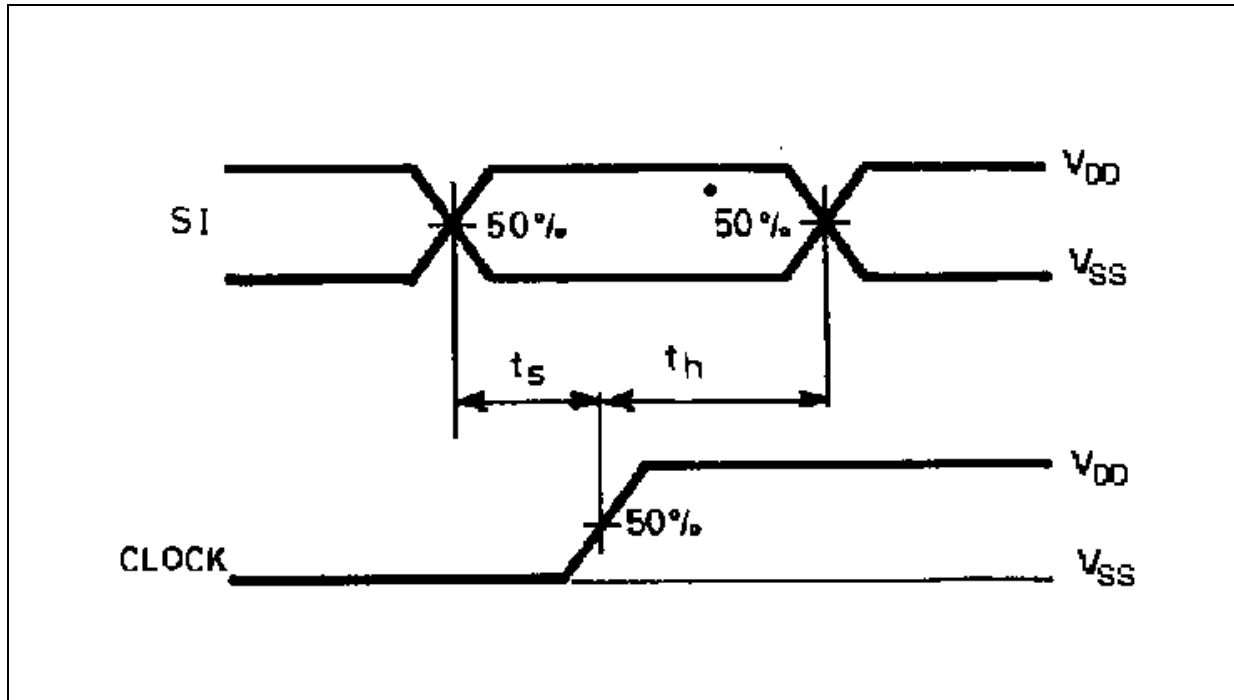
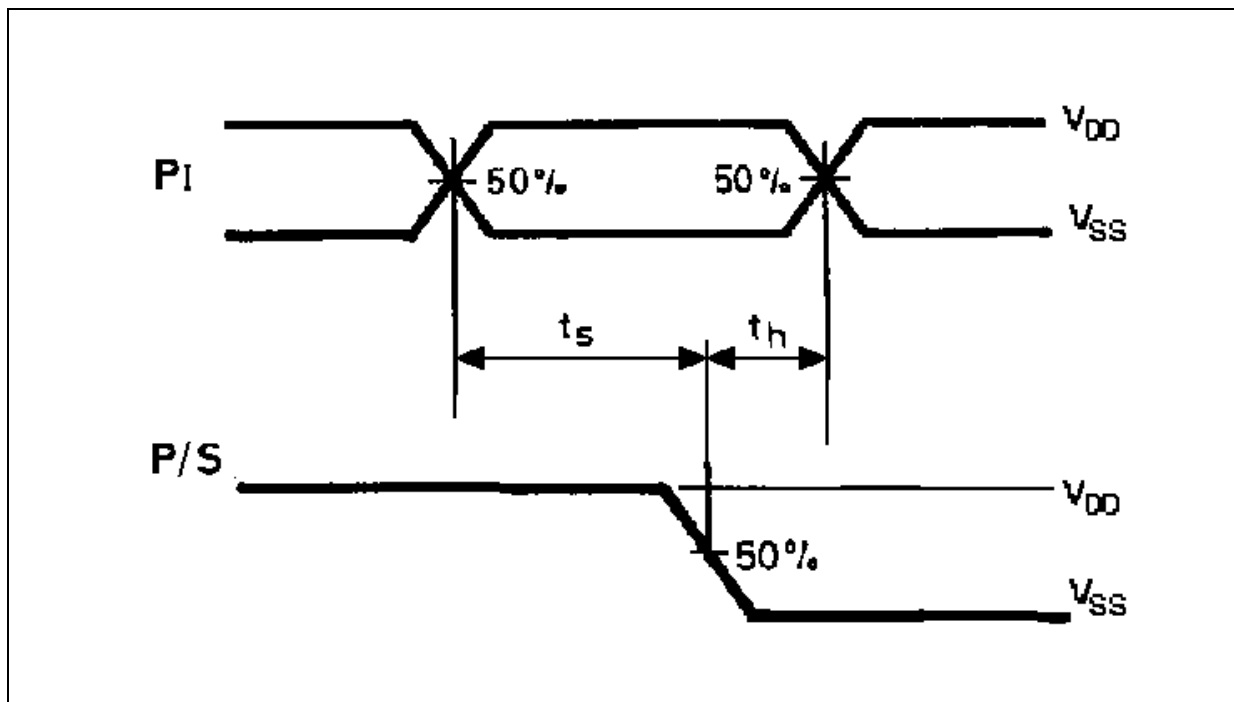
TEST CIRCUIT



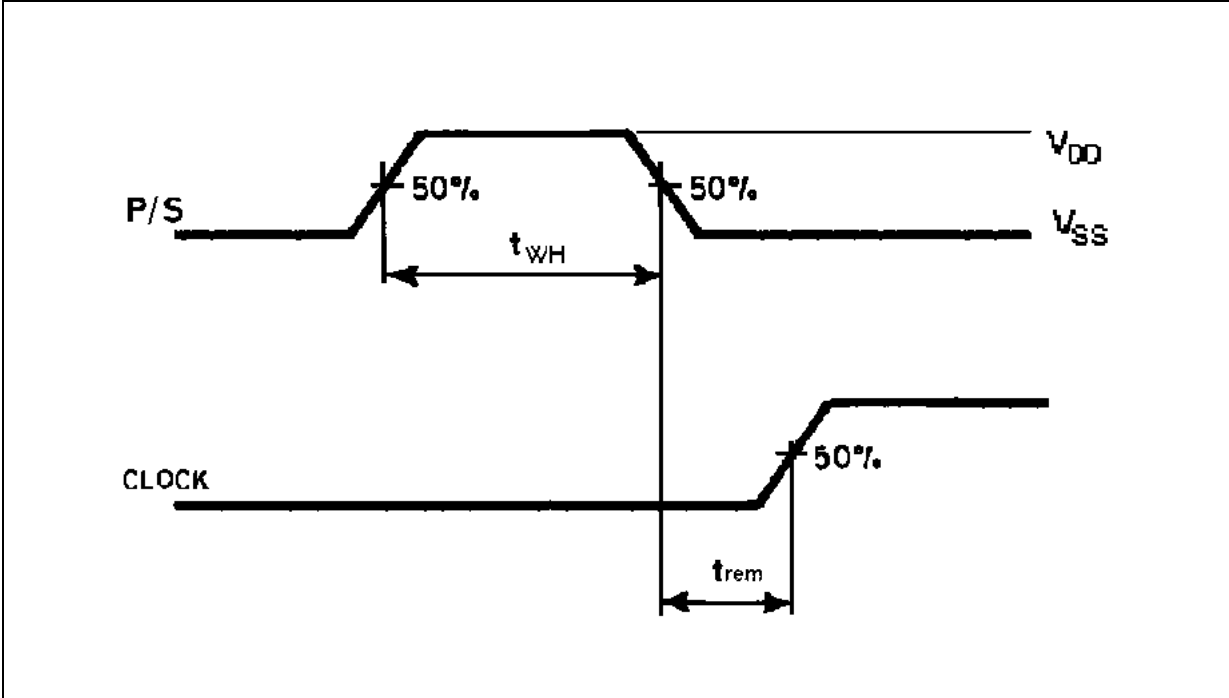
$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = 200\text{K}\Omega$   
 $R_T = Z_{\text{OUT}}$  of pulse generator (typically  $50\Omega$ )

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



WAVEFORM 2 : SETUP AND HOLD TIMES (SI TO CLOCK) ( $f=1\text{MHz}$ ; 50% duty cycle)WAVEFORM 3 : SETUP AND HOLD TIME (PI TO P/S) ( $f=1\text{MHz}$ ; 50% duty cycle)

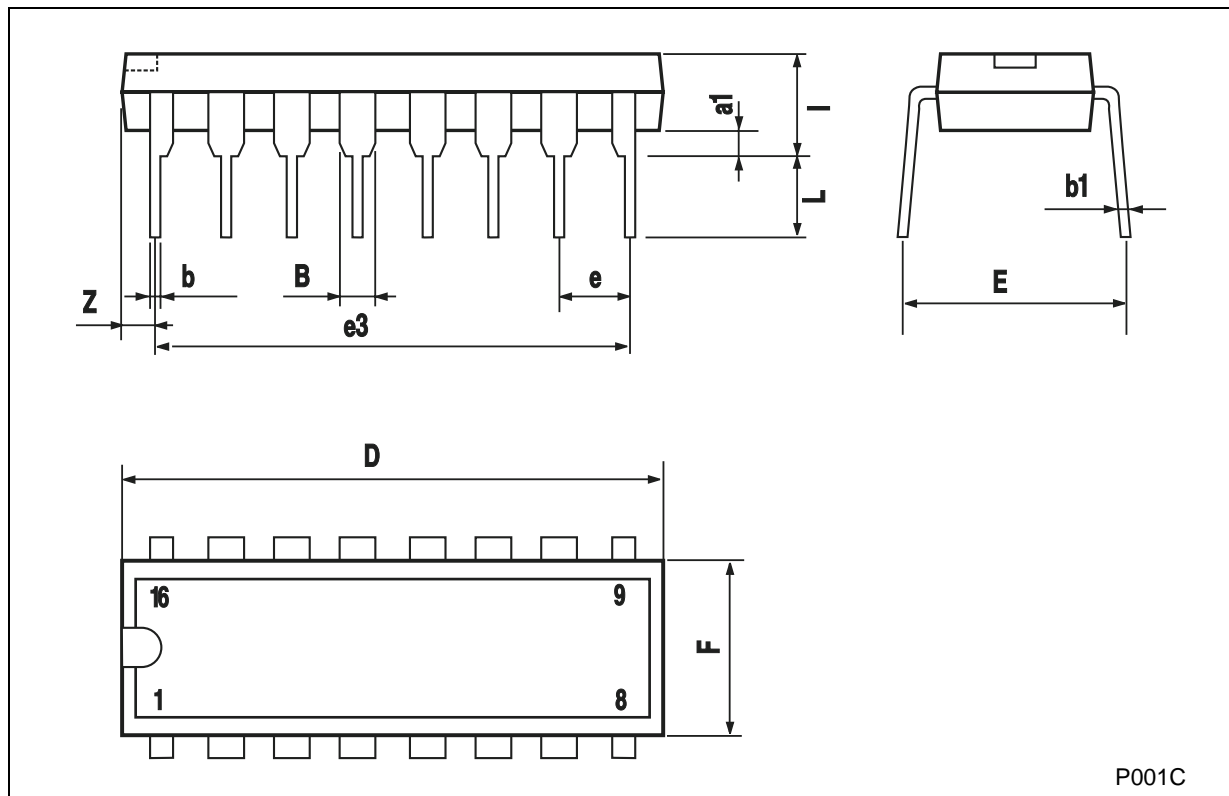
WAVEFORM 4 : PULSE WIDTH AND REMOVAL TIME (P/S TO CLOCK) (f=1MHz; 50% duty cycle)





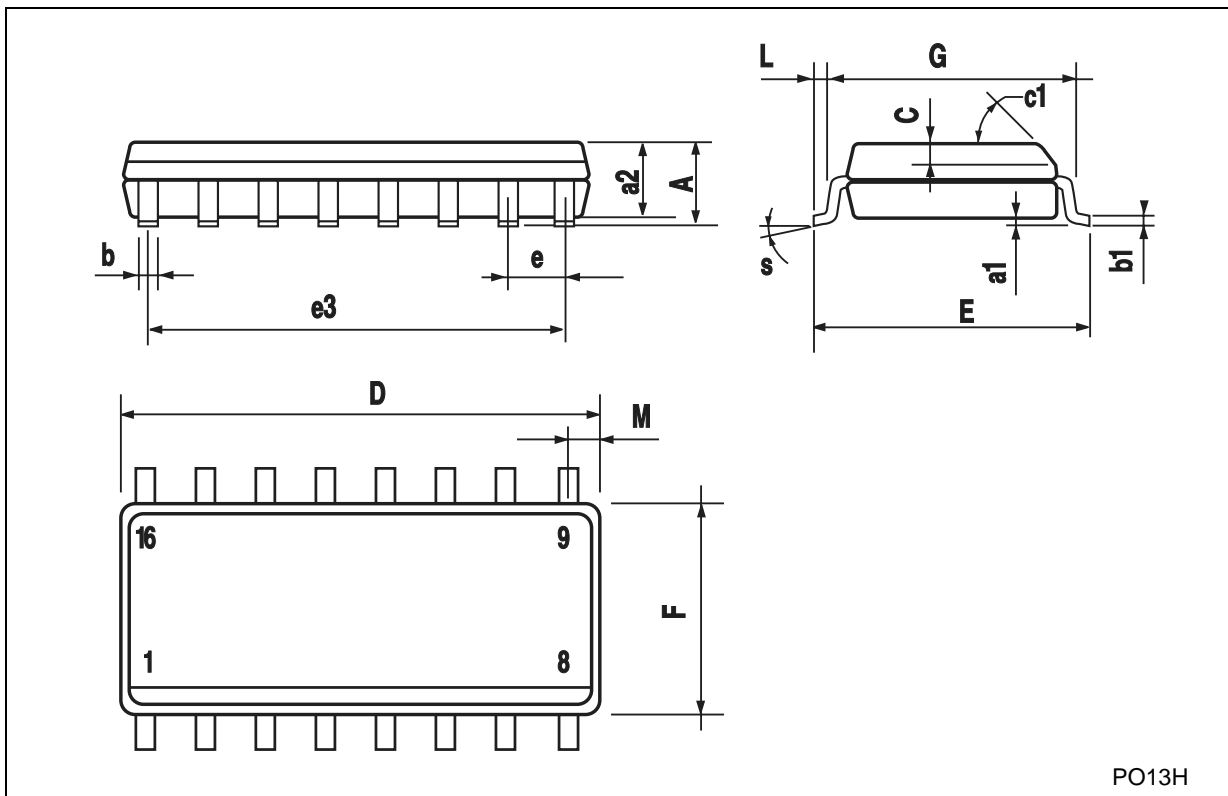
**Plastic DIP-16 (0.25) MECHANICAL DATA**

| 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 |



**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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