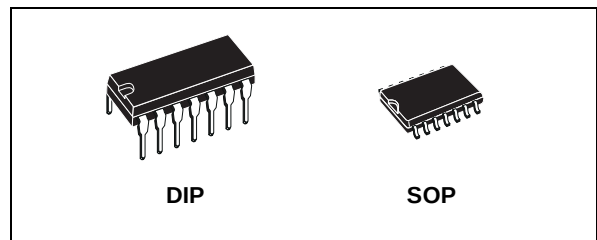


## GATED J-K MASTER SLAVE FLIP-FLOP

- 16MHz TOGGLE RATE (Typ.) at  $V_{DD} - V_{SS} = 10V$
- GATED INPUTS
- 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

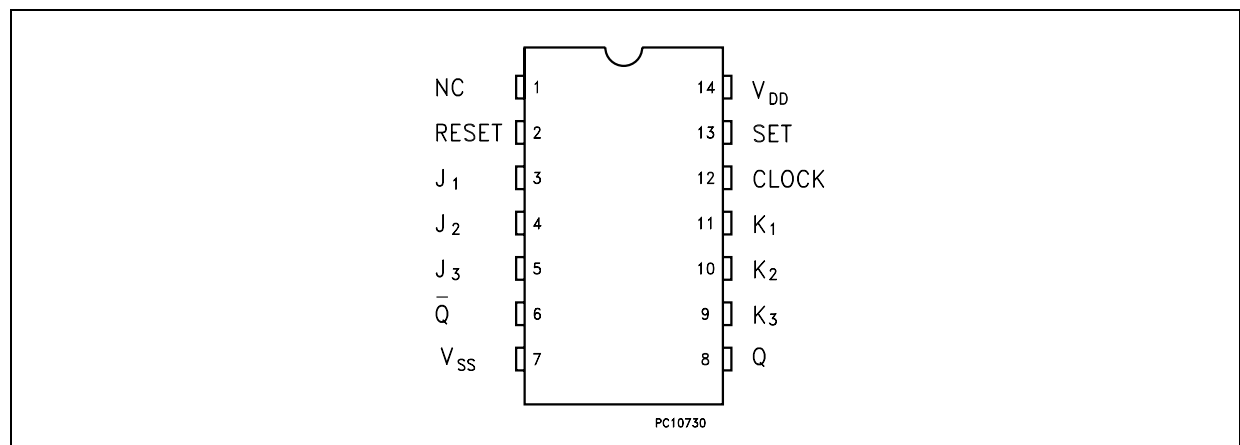
| PACKAGE | TUBE       | T & R         |
|---------|------------|---------------|
| DIP     | HCF4095BEY |               |
| SOP     | HCF4095BM1 | HCF4095M013TR |

### DESCRIPTION

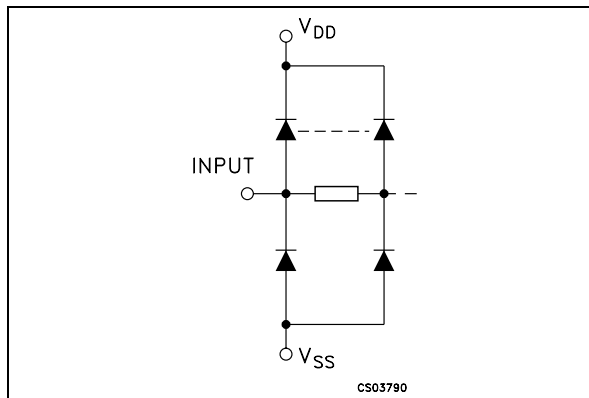
HCF4095B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages. HCF4095B is J-K Master-Slave Flip-Flops featuring separate AND gating of multiple J and K inputs. The gated J-K input control transfers

information into the master section during clocked operation. Information on the J-K inputs is transferred to the Q and  $\bar{Q}$  outputs on the positive edge of the clock pulse. SET and RESET inputs (active high) are provided for asynchronous operation.

### PIN CONNECTION



## INPUT EQUIVALENT CIRCUIT



## PIN DESCRIPTION

| PIN No    | SYMBOL          | NAME AND FUNCTION         |
|-----------|-----------------|---------------------------|
| 3, 4, 5   | J1 to J3        | J Inputs                  |
| 11, 10, 9 | K1 to K3        | K Inputs                  |
| 8         | Q               | Q Output                  |
| 6         | Q               | Q Output                  |
| 13        | SET (S)         | Set Inputs(Active High)   |
| 2         | RESET (R)       | Reset Inputs(Active High) |
| 12        | CLOCK           | Clock Inputs              |
| 1         | NC              | Not Connected             |
| 7         | V <sub>SS</sub> | Negative Supply Voltage   |
| 14        | V <sub>DD</sub> | Positive Supply Voltage   |

## TRUTH TABLE : SYNCHRONOUS OPERATION (S=0 R=0)

| INPUTS BEFORE POSITIVE CLOCK TRANSITION |    | OUTPUTS AFTER POSITIVE CLOCK TRANSITION |           |
|-----------------------------------------|----|-----------------------------------------|-----------|
| J*                                      | K* | Q                                       | $\bar{Q}$ |
| L                                       | L  | NO CHANGE                               |           |
| L                                       | H  | L                                       | H         |
| H                                       | L  | H                                       | L         |
| H                                       | H  | TOGGLES                                 |           |

(\*) : J=J1 • J2 • J3, K=K1 • K2 • K3

## TRUTH TABLE : ASYNCHRONOUS OPERATION (J and K DON'T CARE)

| INPUTS BEFORE POSITIVE CLOCK TRANSITION |   | OUTPUTS AFTER POSITIVE CLOCK TRANSITION |           |
|-----------------------------------------|---|-----------------------------------------|-----------|
| S                                       | R | Q                                       | $\bar{Q}$ |
| L                                       | L | NO CHANGE                               |           |
| L                                       | H | L                                       | H         |
| H                                       | L | H                                       | L         |
| H                                       | H | L                                       | L         |

(\*) : L = V<sub>ss</sub>, H = V<sub>dd</sub>



## 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                      |                       | 0.02 | 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 <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 |      | -1.15       |      | -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 <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          |      |      |

| 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>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 |      |

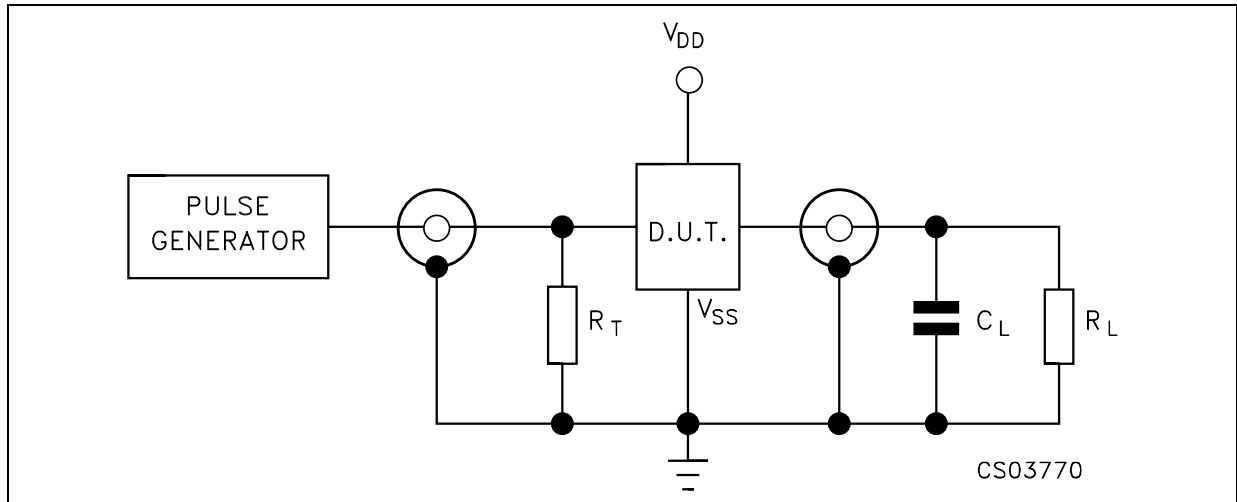
The Noise Margin for both "1" and "0" level is: 1V min. with V<sub>DD</sub>=5V, 2V min. with V<sub>DD</sub>=10V, 2.5V min. with V<sub>DD</sub>=15V

#### DYNAMIC ELECTRICAL CHARACTERISTICS (T<sub>amb</sub> = 25°C, C<sub>L</sub> = 50pF, R<sub>L</sub> = 200K $\Omega$ , t<sub>r</sub> = t<sub>f</sub> = 20 ns)

| Symbol                            | Parameter                                | Test Condition      |  | Value (*) |      |      | Unit    |
|-----------------------------------|------------------------------------------|---------------------|--|-----------|------|------|---------|
|                                   |                                          | V <sub>DD</sub> (V) |  | Min.      | Typ. | Max. |         |
| t <sub>PLH</sub> t <sub>PHL</sub> | Propagation Delay Time                   | 5                   |  |           | 250  | 500  | ns      |
|                                   |                                          | 10                  |  |           | 100  | 200  |         |
|                                   |                                          | 15                  |  |           | 75   | 150  |         |
| t <sub>PLH</sub> t <sub>PHL</sub> | Propagation Delay Time<br>(Set or Reset) | 5                   |  |           | 150  | 300  | ns      |
|                                   |                                          | 10                  |  |           | 75   | 150  |         |
|                                   |                                          | 15                  |  |           | 50   | 100  |         |
| t <sub>TLH</sub> t <sub>THL</sub> | Transition Time                          | 5                   |  |           | 100  | 200  | ns      |
|                                   |                                          | 10                  |  |           | 50   | 100  |         |
|                                   |                                          | 15                  |  |           | 40   | 80   |         |
| f <sub>CL</sub>                   | Maximum Clock Input Frequency            | 5                   |  | 3.5       | 7    |      | MHz     |
|                                   |                                          | 10                  |  | 8         | 16   |      |         |
|                                   |                                          | 15                  |  | 12        | 24   |      |         |
| t <sub>W</sub>                    | Clock Pulse Width                        | 5                   |  | 140       | 70   |      | ns      |
|                                   |                                          | 10                  |  | 60        | 30   |      |         |
|                                   |                                          | 15                  |  | 40        | 20   |      |         |
| t <sub>r</sub> , t <sub>f</sub>   | Clock input Rise or Fall Time            | 5                   |  |           |      | 15   | $\mu$ s |
|                                   |                                          | 10                  |  |           |      | 5    |         |
|                                   |                                          | 15                  |  |           |      | 5    |         |
| t <sub>W</sub>                    | Set or Reset Pulse Width                 | 5                   |  | 200       | 100  |      | ns      |
|                                   |                                          | 10                  |  | 100       | 50   |      |         |
|                                   |                                          | 15                  |  | 50        | 25   |      |         |
| t <sub>setup</sub>                | Data Setup Time                          | 5                   |  | 400       | 200  |      | ns      |
|                                   |                                          | 10                  |  | 160       | 80   |      |         |
|                                   |                                          | 15                  |  | 100       | 50   |      |         |

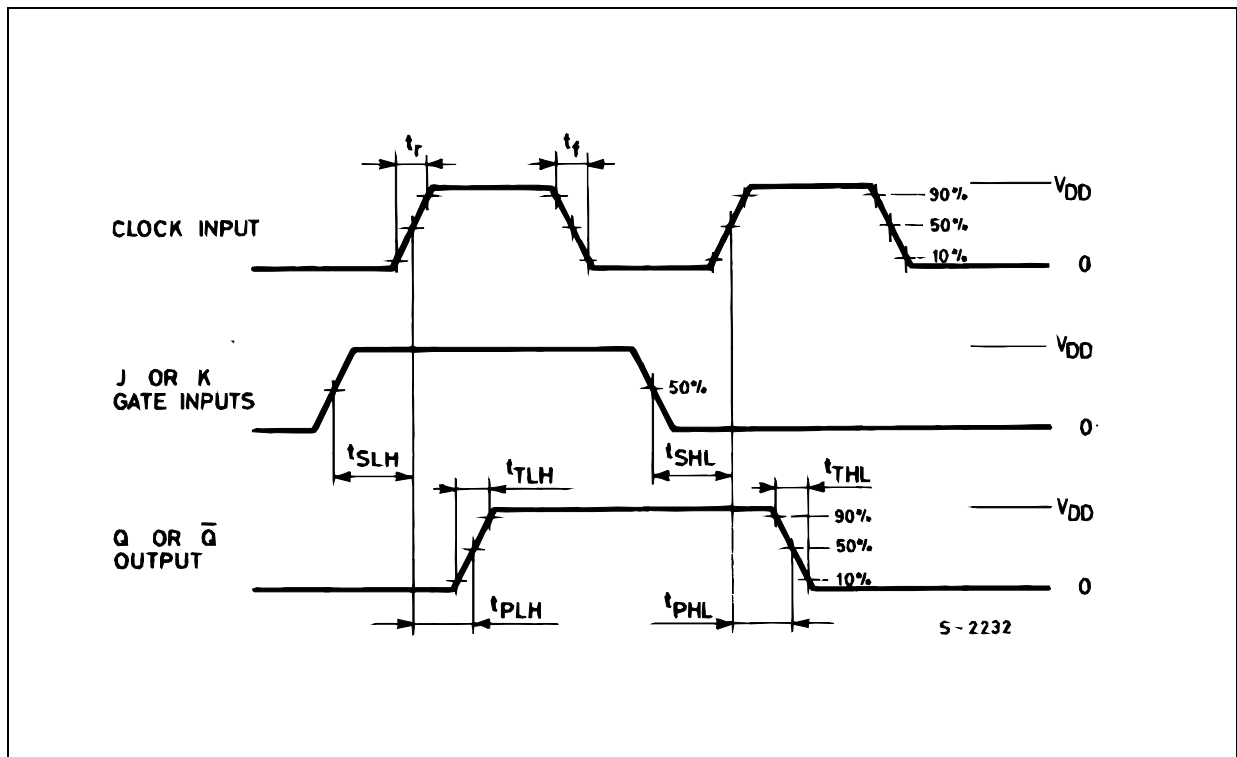
(\*) Typical temperature coefficient for all V<sub>DD</sub> value is 0.3 %/°C.

## TEST CIRCUIT

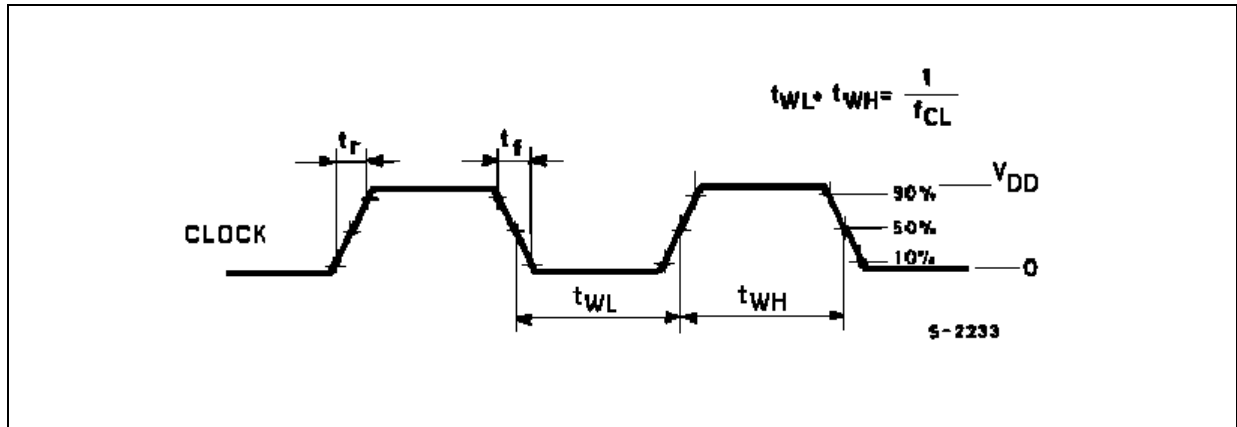


$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = 200\text{k}\Omega$   
 $R_T = Z_{\text{OUT}}$  of pulse generator (typically  $50\Omega$ )

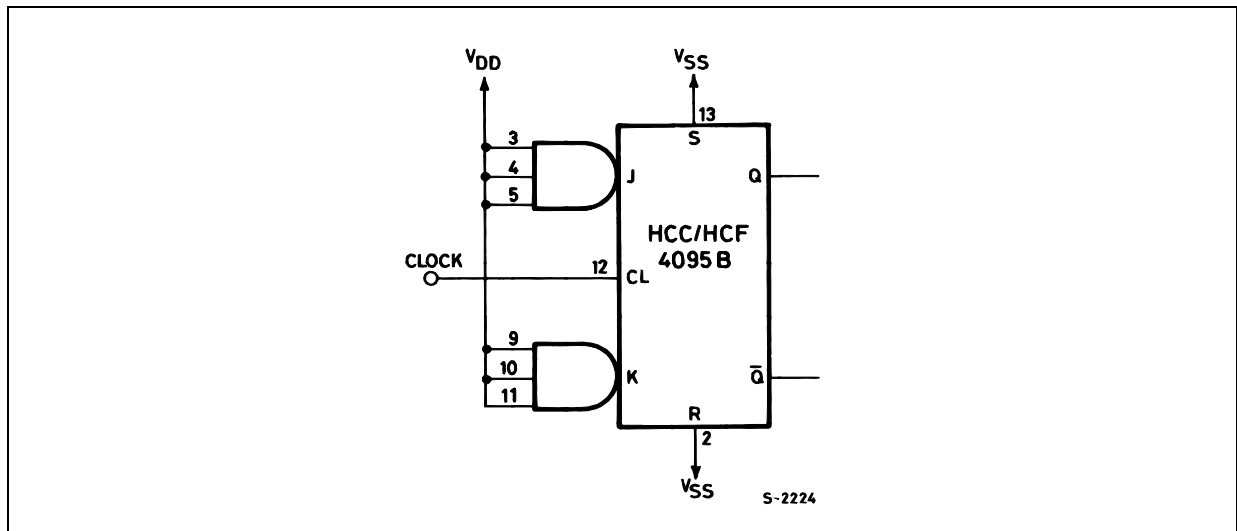
## WAVEFORM : PROPAGATION DELAY, TRANSITION AND SETUP TIME



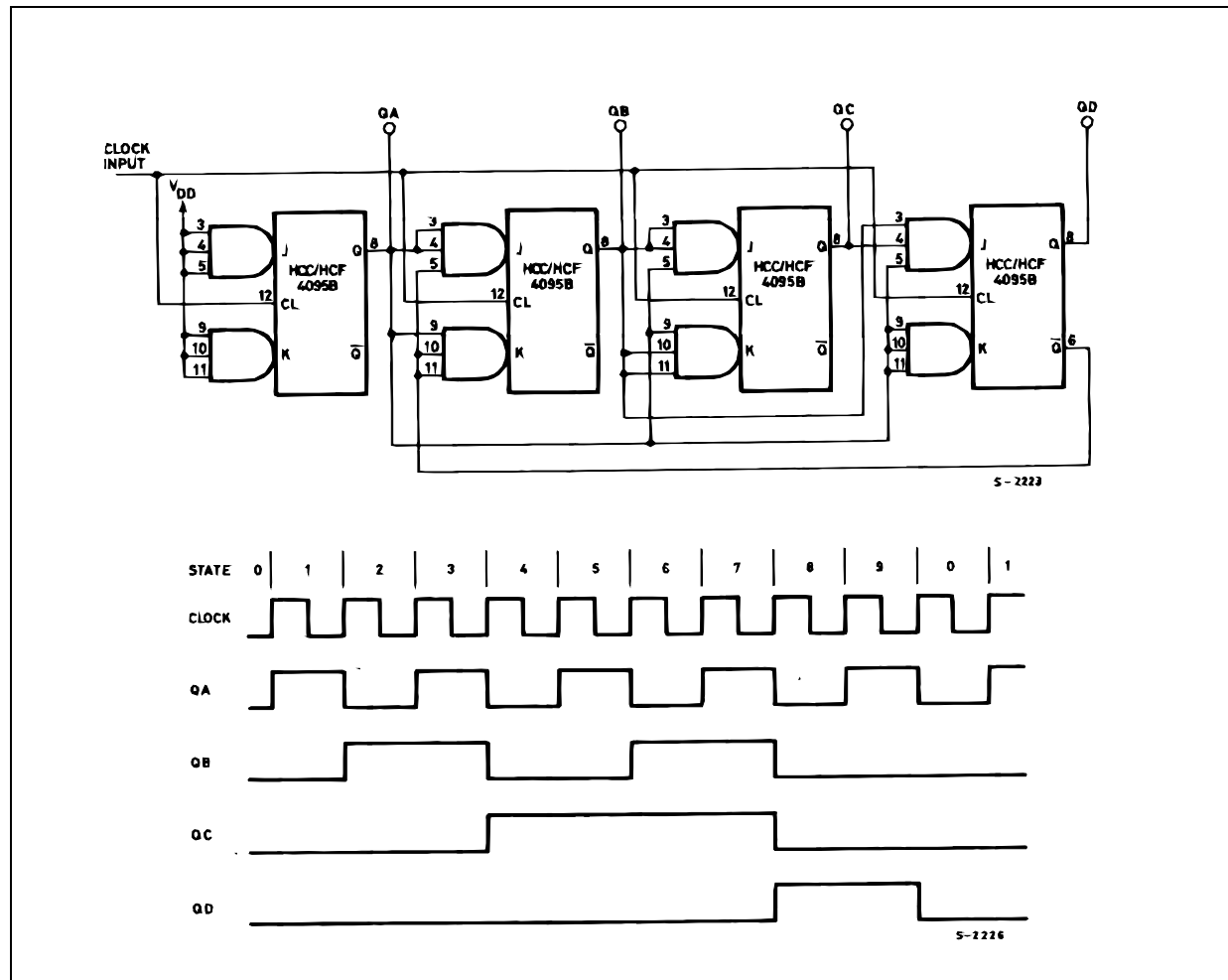
## WAVEFORM : CLOCK PULSE, RISE AND FALL TIME



## TYPICAL APPLICATION: T-TYPE FLIP-FLOP



## TYPICAL APPLICATION: SYNCHRONOUS BINARY DIVIDE BY TEN COUNTER



## TRUTH TABLE

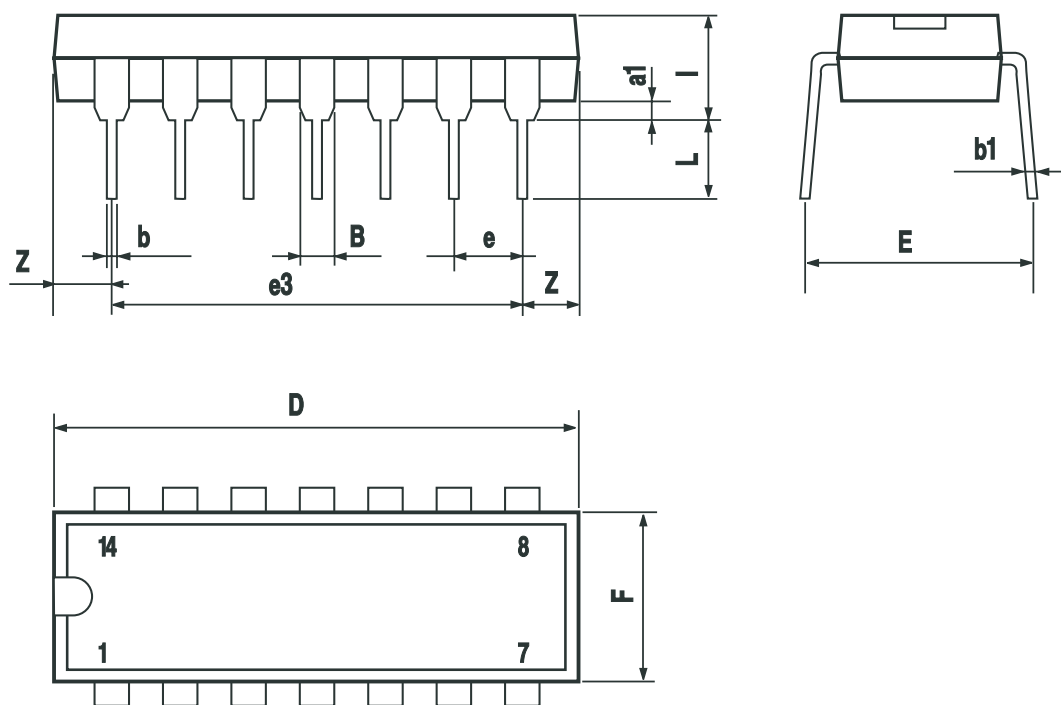
| STATE | QA | QB | QC | QD |
|-------|----|----|----|----|
| 0     | L  | L  | L  | L  |
| 1     | H  | L  | L  | L  |
| 2     | L  | H  | L  | L  |
| 3     | H  | H  | L  | L  |
| 4     | L  | L  | H  | L  |
| 5     | H  | L  | H  | L  |
| 6     | L  | H  | H  | L  |
| 7     | H  | H  | H  | L  |
| 8     | L  | L  | L  | H  |
| 9     | H  | L  | L  | H  |

NOTE: In all units the Set and Reset are Connected to V<sub>SS</sub>.



### Plastic DIP-14 MECHANICAL DATA

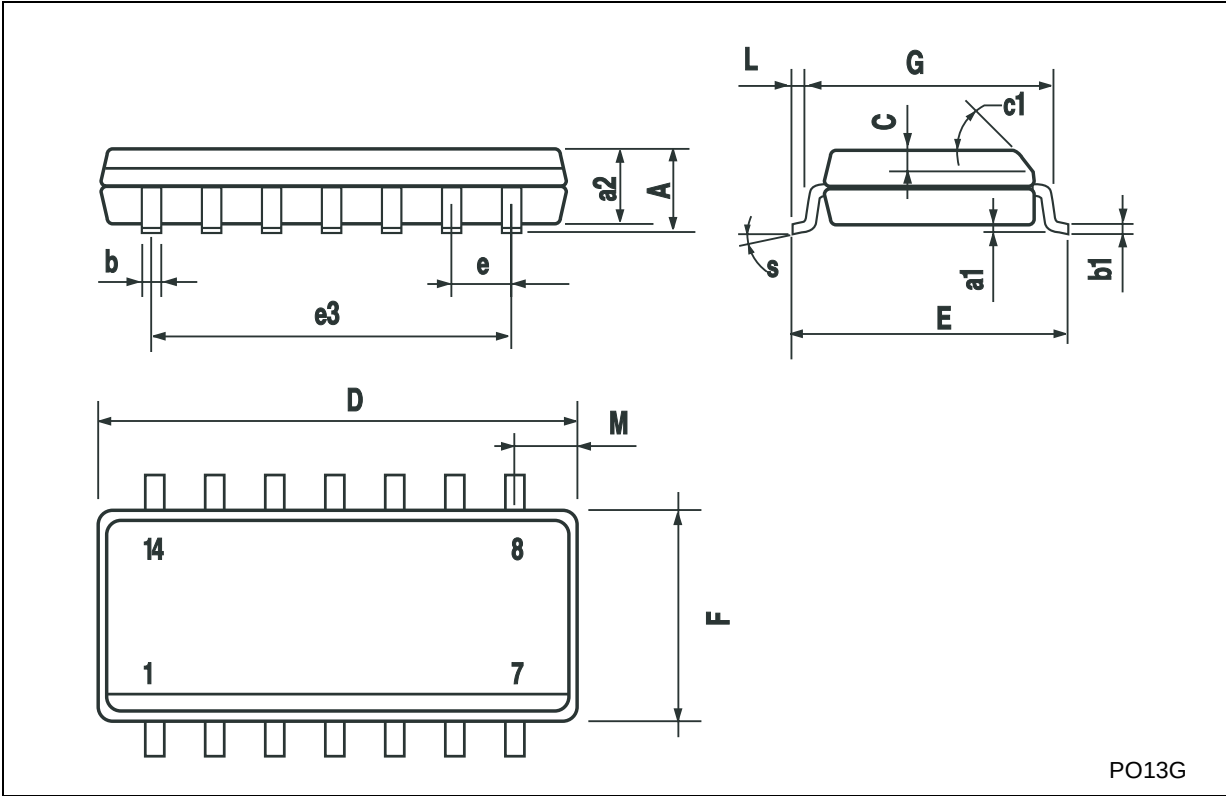
| DIM. | mm.  |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP   | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 1.39 |       | 1.65 | 0.055 |       | 0.065 |
| b    |      | 0.5   |      |       | 0.020 |       |
| b1   |      | 0.25  |      |       | 0.010 |       |
| D    |      |       | 20   |       |       | 0.787 |
| E    |      | 8.5   |      |       | 0.335 |       |
| e    |      | 2.54  |      |       | 0.100 |       |
| e3   |      | 15.24 |      |       | 0.600 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    | 1.27 |       | 2.54 | 0.050 |       | 0.100 |



P001A

SO-14 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    | 8.55       |      | 8.75 | 0.336 |       | 0.344 |
| E    | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e    |            | 1.27 |      |       | 0.050 |       |
| e3   |            | 7.62 |      |       | 0.300 |       |
| 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    |            |      | 0.68 |       |       | 0.026 |
| S    | 8° (max.)  |      |      |       |       |       |



Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

© The ST logo is a registered trademark of STMicroelectronics

© 2002 STMicroelectronics - Printed in Italy - All Rights Reserved  
STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - Canada - China - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco  
Singapore - Spain - Sweden - Switzerland - United Kingdom - United States.

© <http://www.st.com>