

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

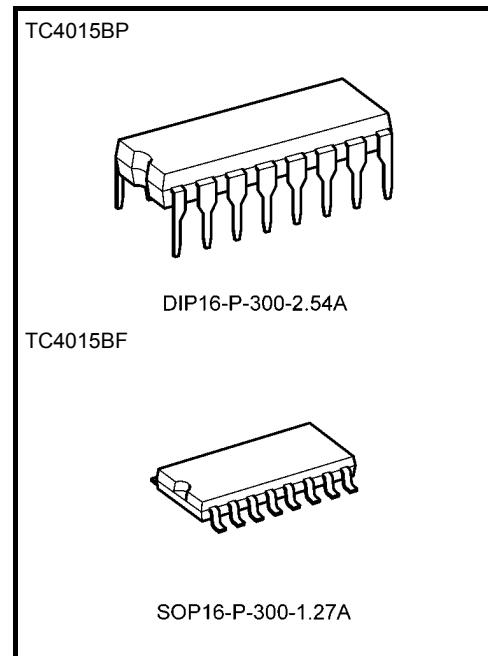
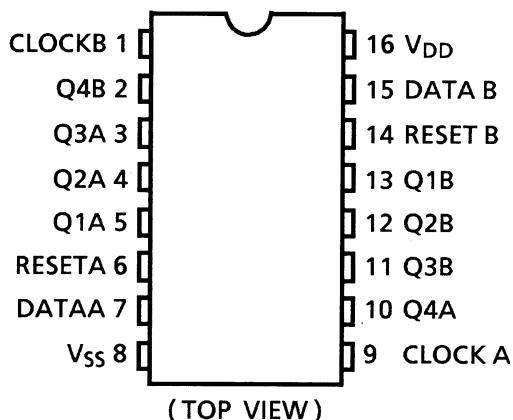
**TC4015BP,TC4015BF**

TC4015B Dual 4-Stage Static Shift Register  
(with serial input/parallel output)

TC4015B contains two circuits of 4 stage shift registers and the independent output is driven from each stage. As all the D type flip-flops of every stage have common RESET input, asynchronous clear operation can be achieved by an external signal at arbitrary timing. The flip-flop of each stage is triggered by rising edge of CLOCK input.

RESET input of "H" level resets the contents of all the stages to "L" regardless of CLOCK and DATA inputs and all of data outputs Q1 through Q4 become "L".

This can be used for converting serial data to parallel one and for ring counters of any numbering systems.

**Pin Assignment**

Weight  
DIP16-P-300-2.54A : 1.00 g (typ.)  
SOP16-P-300-1.27A : 0.18 g (typ.)

**Truth Table**

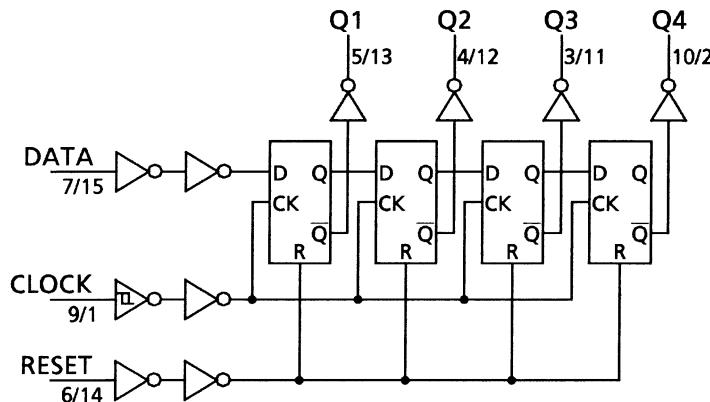
| Inputs         |      |       | Outputs   |    |    |    |
|----------------|------|-------|-----------|----|----|----|
| CLOCK $\Delta$ | DATA | RESET | Q1        | Q2 | Q3 | Q4 |
| $\uparrow$     | L    | L     | L         | Q1 | Q2 | Q3 |
| $\uparrow$     | H    | L     | H         | Q1 | Q2 | Q3 |
| $\downarrow$   | *    | L     | No Change |    |    |    |
| *              | *    | H     | L         | L  | L  | L  |

$\Delta$ : Level change

\*: Don't care

## Logic Diagram

## 1/2 TC4015B



## Absolute Maximum Ratings (Note)

| Characteristics             | Symbol    | Rating                           | Unit |
|-----------------------------|-----------|----------------------------------|------|
| DC supply voltage           | $V_{DD}$  | $V_{SS} - 0.5 \sim V_{SS} + 20$  | V    |
| Input voltage               | $V_{IN}$  | $V_{SS} - 0.5 \sim V_{DD} + 0.5$ | V    |
| Output voltage              | $V_{OUT}$ | $V_{SS} - 0.5 \sim V_{DD} + 0.5$ | V    |
| DC input current            | $I_{IN}$  | $\pm 10$                         | mA   |
| Power dissipation           | $P_D$     | 300 (DIP)/180 (SOIC)             | mW   |
| Operating temperature range | $T_{opr}$ | -40~85                           | °C   |
| Storage temperature range   | $T_{stg}$ | -65~150                          | °C   |

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

Operating Ranges ( $V_{SS} = 0$  V) (Note)

| Characteristics   | Symbol   | Test Condition | Min | Typ. | Max      | Unit |
|-------------------|----------|----------------|-----|------|----------|------|
| DC supply voltage | $V_{DD}$ | —              | 3   | —    | 18       | V    |
| Input voltage     | $V_{IN}$ | —              | 0   | —    | $V_{DD}$ | V    |

Note: The operating ranges must be maintained to ensure the normal operation of the device.

Unused inputs must be tied to either  $V_{DD}$  or  $V_{SS}$ .

Static Electrical Characteristics (V<sub>SS</sub> = 0 V)

| Characteristics           | Symbol          | Test Condition  | -40°C                  |       | 25°C |       |       | 85°C              |       | Unit |      |    |
|---------------------------|-----------------|---|------------------------|-------|------|-------|-------|-------------------|-------|------|------|----|
|                           |                 |   | V <sub>DD</sub> (V)    | Min   | Max  | Min   | Typ.  | Max               | Min   |      |      |    |
| High-level output voltage | V <sub>OH</sub> | I <sub>OUT</sub>   < 1 μA<br>V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>                          | 5                      | 4.95  | —    | 4.95  | 5.00  | —                 | 4.95  | —    | V    |    |
|                           |                 |   | 10                     | 9.95  | —    | 9.95  | 10.00 | —                 | 9.95  | —    |      |    |
|                           |                 |   | 15                     | 14.95 | —    | 14.95 | 15.00 | —                 | 14.95 | —    |      |    |
| Low-level output voltage  | V <sub>OL</sub> | I <sub>OUT</sub>   < 1 μA<br>V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>                          | 5                      | —     | 0.05 | —     | 0.00  | 0.05              | —     | 0.05 | V    |    |
|                           |                 |   | 10                     | —     | 0.05 | —     | 0.00  | 0.05              | —     | 0.05 |      |    |
|                           |                 |   | 15                     | —     | 0.05 | —     | 0.00  | 0.05              | —     | 0.05 |      |    |
| Output high current       | I <sub>OH</sub> | V <sub>OH</sub> = 4.6 V<br>V <sub>OH</sub> = 2.5 V<br>V <sub>OH</sub> = 9.5 V<br>V <sub>OH</sub> = 13.5 V | 5                      | -0.61 | —    | -0.51 | -1.0  | —                 | -0.42 | —    | mA   |    |
|                           |                 |   | 5                      | -2.50 | —    | -2.10 | -4.0  | —                 | -1.70 | —    |      |    |
|                           |                 |   | 10                     | -1.50 | —    | -1.30 | -2.2  | —                 | -1.10 | —    |      |    |
|                           |                 |   | 15                     | -4.00 | —    | -3.40 | -9.0  | —                 | -2.80 | —    |      |    |
|                           |                 | V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>   |                        |       |      |       |       |                   |       |      |      |    |
| Output low current        | I <sub>OL</sub> | V <sub>OL</sub> = 0.4 V<br>V <sub>OL</sub> = 0.5 V<br>V <sub>OL</sub> = 1.5 V                             | 5                      | 0.61  | —    | 0.51  | 1.2   | —                 | 0.42  | —    | mA   |    |
|                           |                 |   | 10                     | 1.50  | —    | 1.30  | 3.2   | —                 | 1.10  | —    |      |    |
|                           |                 |   | 15                     | 4.00  | —    | 3.40  | 12.0  | —                 | 2.80  | —    |      |    |
|                           |                 | V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>   |                        |       |      |       |       |                   |       |      |      |    |
| Input high voltage        | V <sub>IH</sub> | V <sub>OUT</sub> = 0.5 V, 4.5 V<br>V <sub>OUT</sub> = 1.0 V, 9.0 V<br>V <sub>OUT</sub> = 1.5 V, 13.5 V    | 5                      | 3.5   | —    | 3.5   | 2.75  | —                 | 3.5   | —    | V    |    |
|                           |                 |   | 10                     | 7.0   | —    | 7.0   | 5.50  | —                 | 7.0   | —    |      |    |
|                           |                 |   | 15                     | 11.0  | —    | 11.0  | 8.25  | —                 | 11.0  | —    |      |    |
|                           |                 | I <sub>OUT</sub>   < 1 μA   |                        |       |      |       |       |                   |       |      |      |    |
| Input low voltage         | V <sub>IL</sub> | V <sub>OUT</sub> = 0.5 V, 4.5 V<br>V <sub>OUT</sub> = 1.0 V, 9.0 V<br>V <sub>OUT</sub> = 1.5 V, 13.5 V    | 5                      | —     | 1.5  | —     | 2.25  | 1.5               | —     | 1.5  | V    |    |
|                           |                 |   | 10                     | —     | 3.0  | —     | 4.50  | 3.0               | —     | 3.0  |      |    |
|                           |                 |   | 15                     | —     | 4.0  | —     | 6.75  | 4.0               | —     | 4.0  |      |    |
|                           |                 | I <sub>OUT</sub>   < 1 μA   |                        |       |      |       |       |                   |       |      |      |    |
| Input current             | "H" level       | I <sub>IH</sub>   | V <sub>IH</sub> = 18 V | 18    | —    | 0.1   | —     | 10 <sup>-5</sup>  | 0.1   | —    | 1.0  | μA |
|                           | "L" level       | I <sub>IL</sub>   | V <sub>IL</sub> = 0 V  | 18    | —    | -0.1  | —     | -10 <sup>-5</sup> | -0.1  | —    | -1.0 |    |
| Quiescent supply current  | I <sub>DD</sub> | V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub><br>(Note)   | 5                      | —     | 5    | —     | 0.005 | 5                 | —     | 150  | μA   |    |
|                           |                 |   | 10                     | —     | 10   | —     | 0.010 | 10                | —     | 300  |      |    |
|                           |                 |   | 15                     | —     | 20   | —     | 0.015 | 20                | —     | 600  |      |    |

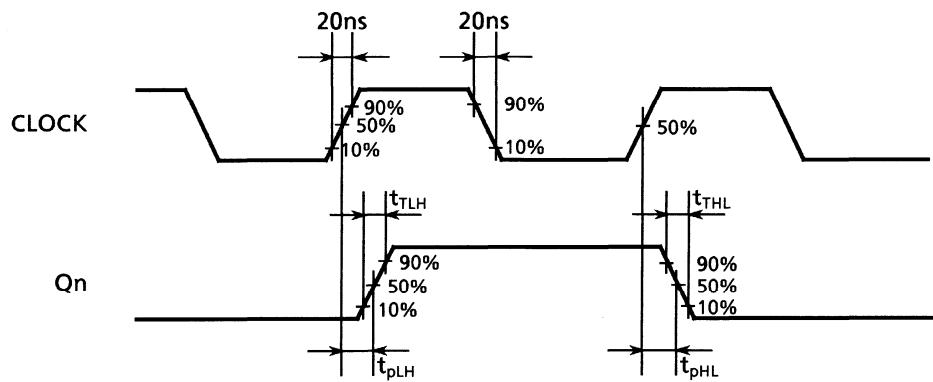
Note: All valid input combinations.

Dynamic Electrical Characteristics (Ta = 25°C, V<sub>SS</sub> = 0 V, C<sub>L</sub> = 50 pF)

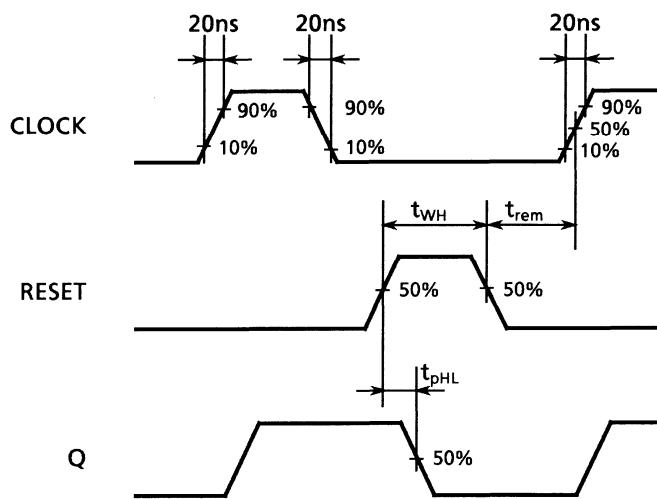
| Characteristics  | Symbol           | Test Condition | V <sub>DD</sub> (V) | Min      | Typ.     | Max | Unit |
|--|------------------|----------------|---------------------|----------|----------|-----|------|
|  |                  |                | 5                   |          |          |     |      |
| Output transition time<br>(low to high)                | t <sub>TLH</sub> | —              | 10                  | —        | 35       | 100 | ns   |
|  |                  |                | 15                  | —        | 30       | 80  | ns   |
|  |                  |                | 5                   | —        | 70       | 200 | ns   |
| Output transition time<br>(high to low)                | t <sub>THL</sub> | —              | 10                  | —        | 35       | 100 | ns   |
|  |                  |                | 15                  | —        | 30       | 80  | ns   |
|  |                  |                | 5                   | —        | 130      | 320 | ns   |
| Propagation delay time<br>(CLOCK-Q)                    | t <sub>pLH</sub> | —              | 10                  | —        | 60       | 160 | ns   |
|  |                  |                | 15                  | —        | 50       | 120 | ns   |
|  |                  |                | 5                   | —        | 90       | 400 | ns   |
| Propagation delay time<br>(RESET-Q)                    | t <sub>pHL</sub> | —              | 10                  | —        | 45       | 200 | ns   |
|  |                  |                | 15                  | —        | 40       | 160 | ns   |
|  |                  |                | 5                   | 3.0      | 8        | —   | MHz  |
| Max clock frequency                                    | f <sub>CL</sub>  | —              | 10                  | 6.0      | 17       | —   | MHz  |
|  |                  |                | 15                  | 8.5      | 20       | —   | MHz  |
|  |                  |                | 5                   | —        | 35       | 180 | ns   |
| Min clock pulse width                                  | t <sub>W</sub>   | —              | 10                  | —        | 25       | 80  | ns   |
|  |                  |                | 15                  | —        | 20       | 50  | ns   |
|  |                  |                | 5                   | —        | 50       | 200 | ns   |
| Min pulse width<br>(RESET)                             | t <sub>WH</sub>  | —              | 10                  | —        | 25       | 80  | ns   |
|  |                  |                | 15                  | —        | 20       | 60  | ns   |
|  |                  |                | 5                   | —        | 8        | 70  | ns   |
| Min set-up time<br>(DATA-CLOCK)                        | t <sub>SU</sub>  | —              | 10                  | —        | 4        | 40  | ns   |
|  |                  |                | 15                  | —        | 0        | 30  | ns   |
|  |                  |                | 5                   | —        | 6        | 60  | ns   |
| Min hold time<br>(DATA-CLOCK)                          | t <sub>H</sub>   | —              | 10                  | —        | 5        | 30  | ns   |
|  |                  |                | 15                  | —        | 4        | 20  | ns   |
|  |                  |                | 5                   | —        | 0        | 80  | ns   |
| Min removal time<br>(RESET-CLOCK)                      | t <sub>rem</sub> | —              | 10                  | —        | 0        | 30  | ns   |
|  |                  |                | 15                  | —        | 0        | 20  | ns   |
|  |                  |                | 5                   | —        | No limit |     |      |
| Max clock input rise time<br>Max clock input fall time | t <sub>rCL</sub> | —              | 10                  | No limit |          |     | μs   |
|  |                  |                | 15                  | No limit |          |     | μs   |
| Input capacitance                                      | C <sub>IN</sub>  | —              | —                   | —        | 5        | 7.5 | pF   |

## Waveforms for Measurement of Dynamic Characteristics

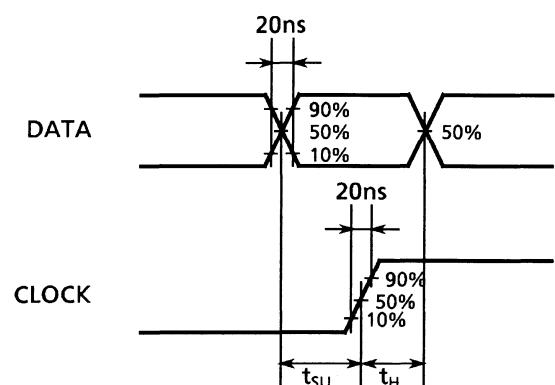
## Waveform 1



## Waveform 2



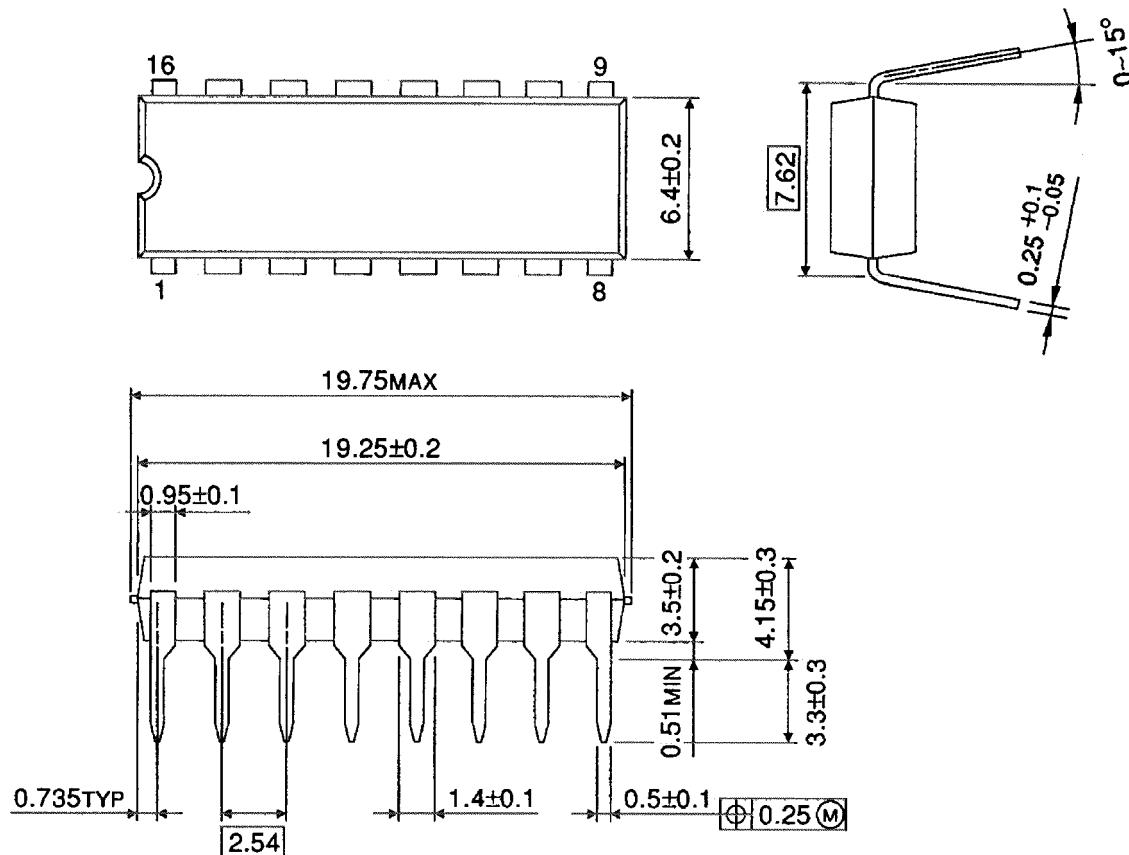
## Waveform 3



**Package Dimensions**

DIP16-P-300-2.54A

Unit : mm

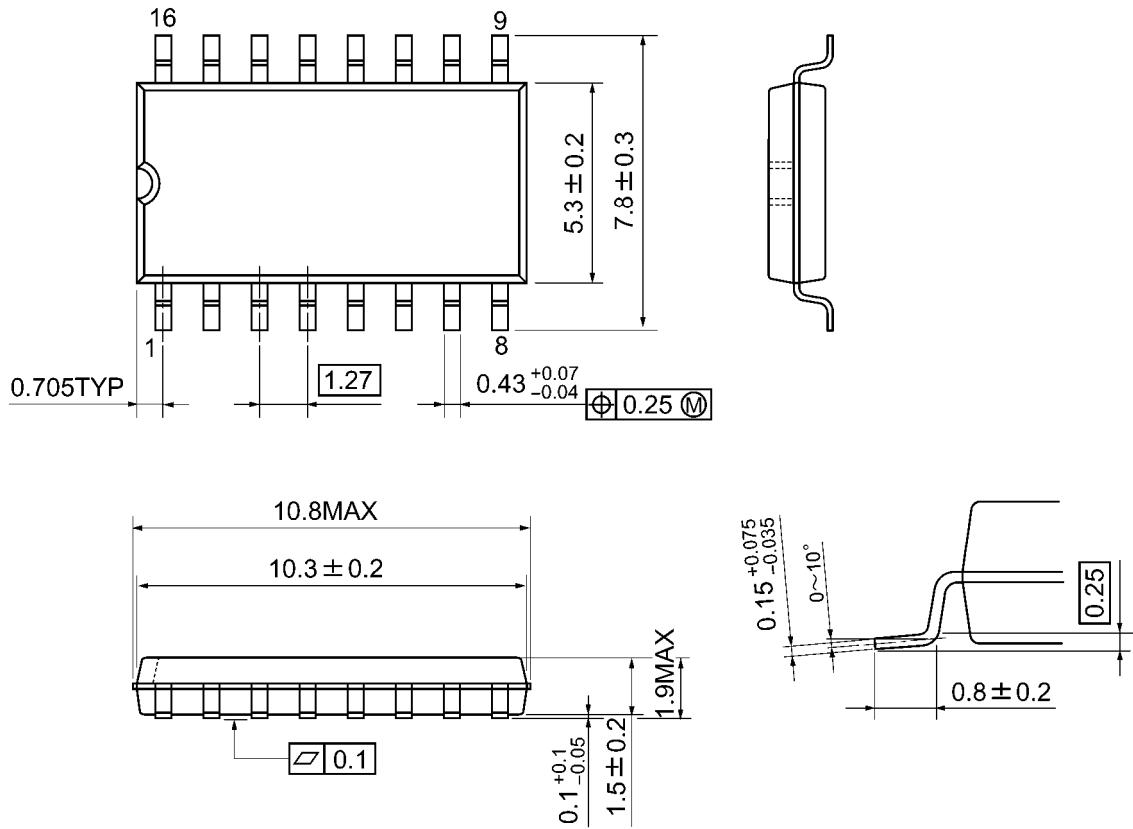


Weight: 1.00 g (typ.)

**Package Dimensions**

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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