

# TC4021BP, TC4021BF, TC4021BFN

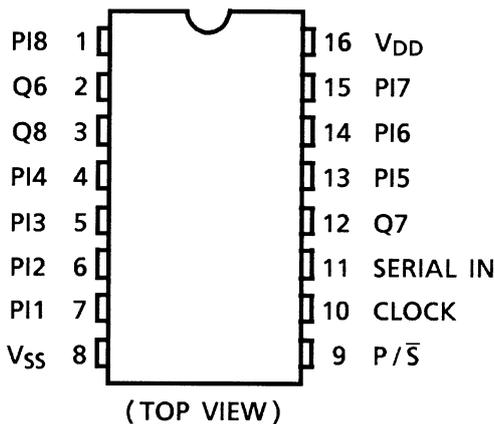
## TC4021B 8-Stage Static Shift Register

(asynchronous parallel input or synchronous serial input/serial output)

TC4021B is 8 stage parallel in/serial out shift register, which can be used also for serial in/serial out operations. In the case of parallel operation, the data of PARALLEL IN is input to each F/F asynchronously with CLOCK and the output is obtained. In the case of serial operations, each F/F is triggered by rising edge of CLOCK. (asynchronous parallel or synchronous serial input)

Switching of PARALLEL operation and SERIAL operation is achieved by  $P/\bar{S}$  CONTROL input. When  $P/\bar{S}$  CONTROL input is "H", PARALLEL operation is designated and when it is "L", SERIAL operation is designated.

### Pin Assignment



### Truth Table

| Inputs               |             |     |        |    | Outputs $\Delta$ |           |
|----------------------|-------------|-----|--------|----|------------------|-----------|
| CLOCK $\Delta\Delta$ | $P/\bar{S}$ | PI1 | PI $n$ | SI | Q1               | Q $n$     |
|                      | L           | *   | *      | L  | L                | Q $n$ - 1 |
|                      | L           | *   | *      | H  | H                | Q $n$ - 1 |
|                      | L           | *   | *      | *  | No Change        |           |
| *                    | H           | L   | L      | *  | L                | L         |
| *                    | H           | L   | H      | *  | L                | H         |
| *                    | H           | H   | L      | *  | H                | L         |
| *                    | H           | H   | H      | *  | H                | H         |

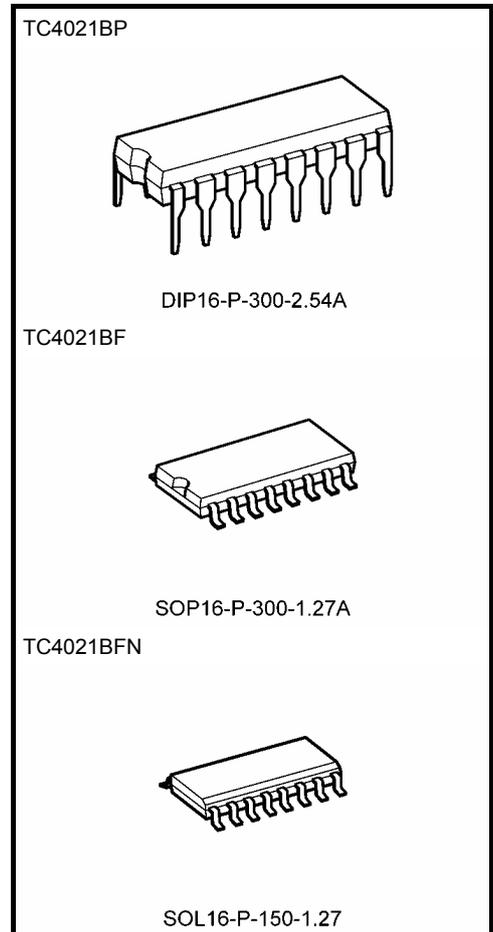
n: 2~8

$\Delta$ : Q1~Q5 internal

$\Delta\Delta$ : Level change

\*: Don't care

Note: xxxFN (JEDEC SOP) is not available in Japan.

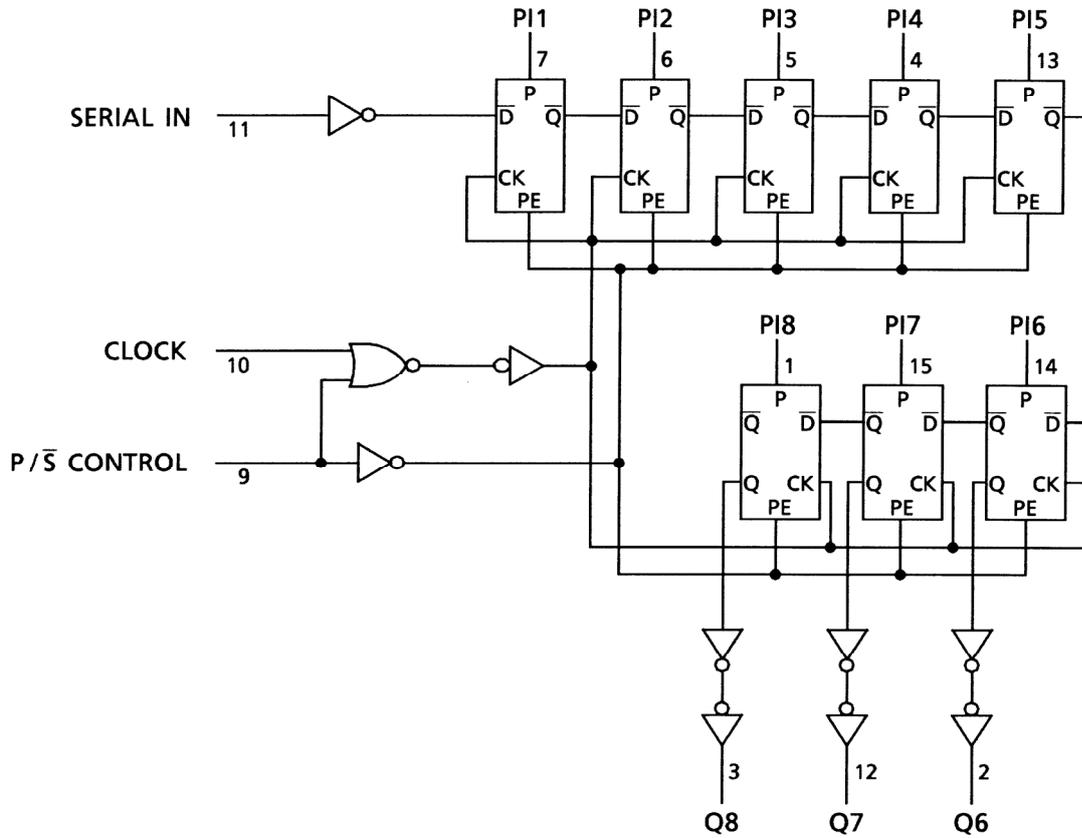


### Weight

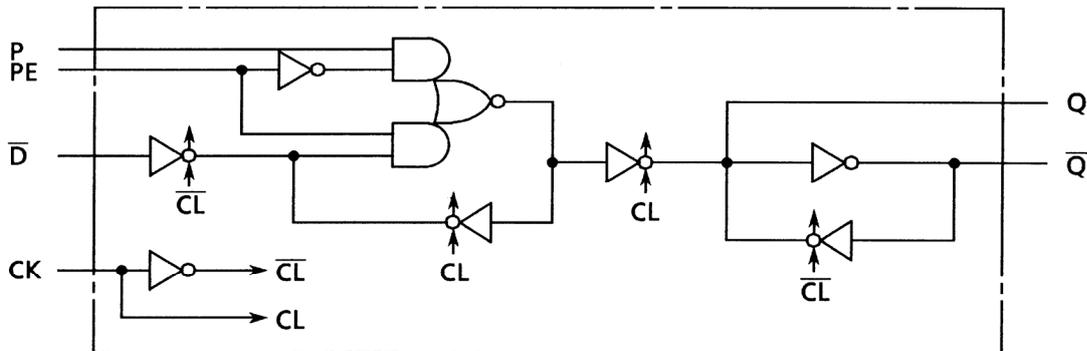
|                   |                 |
|-------------------|-----------------|
| DIP16-P-300-2.54A | : 1.00 g (typ.) |
| SOP16-P-300-1.27A | : 0.18 g (typ.) |
| SOL16-P-150-1.27  | : 0.13 g (typ.) |

**Logic Diagram**

**Parallel**



**Internal Flip Flop**



**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              | Sym-<br>bol     | Test Condition   | V <sub>DD</sub><br>(V) | -40°C |      | 25°C  |       |                   | 85°C  |      | Unit |    |
|------------------------------|-----------------|--|------------------------|-------|------|-------|-------|-------------------|-------|------|------|----|
|                              |                 |  |                        | Min   | Max  | Min   | Typ.  | Max               | Min   | Max  |      |    |
| High-level output<br>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<br>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<br>V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub> | 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 | —    |      |    |
|                              |                 |  |                        |       |      |       |       |                   |       |      |      |    |
| 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<br>V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>                             | 5                      | 0.61  | —    | 0.51  | 1.5   | —                 | 0.42  | —    | mA   |    |
|                              |                 |  | 10                     | 1.50  | —    | 1.30  | 3.8   | —                 | 1.10  | —    |      |    |
|                              |                 |  | 15                     | 4.00  | —    | 3.40  | 15.0  | —                 | 2.80  | —    |      |    |
|                              |                 |  |                        |       |      |       |       |                   |       |      |      |    |
| 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<br> I <sub>OUT</sub>   < 1 μA                             | 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  | —    |      |    |
|                              |                 |  |                        |       |      |       |       |                   |       |      |      |    |
| 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<br> I <sub>OUT</sub>   < 1 μA                             | 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  |      |    |
|                              |                 |  |                        |       |      |       |       |                   |       |      |      |    |
| Input<br>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<br>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   | —     | 0.020 | 20                | —     | 600  |      |    |

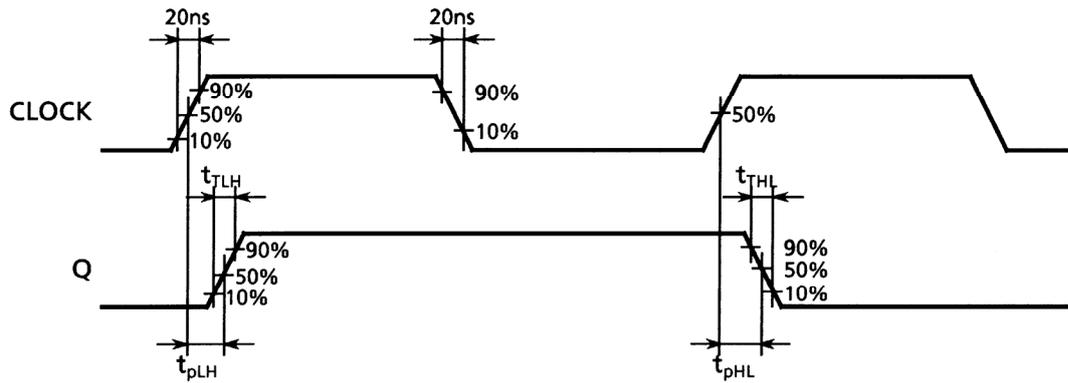
Note: All valid input combinations.

## Dynamic Electrical Characteristics (Ta = 25°C, VSS = 0 V, CL = 50 pF)

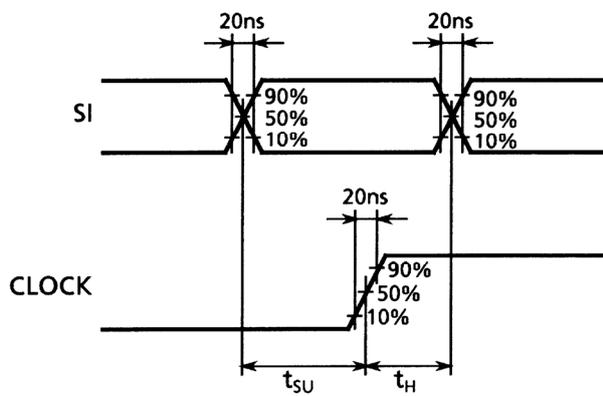
| Characteristics                            | Symbol                               | Test Condition | VDD (V) | Min  | Typ. | Max | Unit |
|--|--------------------------------------|----------------|---------|------|------|-----|------|
|  |                                      |                |         |      |      |     |      |
| Output transition time<br>(low to high)    | t <sub>TLH</sub>                     | —              | 5       | —    | 80   | 200 | ns   |
|  |                                      |                | 10      | —    | 50   | 100 |      |
|  |                                      |                | 15      | —    | 40   | 80  |      |
| Output transition time<br>(high to low)    | t <sub>THL</sub>                     | —              | 5       | —    | 80   | 200 | ns   |
|  |                                      |                | 10      | —    | 50   | 100 |      |
|  |                                      |                | 15      | —    | 40   | 80  |      |
| Propagation delay time<br>(CLOCK-Q)        | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 5       | —    | 150  | 320 | ns   |
|  |                                      |                | 10      | —    | 65   | 160 |      |
|  |                                      |                | 15      | —    | 45   | 120 |      |
| Propagation delay time<br>(P/S-Q)          | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 5       | —    | 230  | 460 | ns   |
|  |                                      |                | 10      | —    | 90   | 180 |      |
|  |                                      |                | 15      | —    | 60   | 120 |      |
| Max clock frequency                        | f <sub>CL</sub>                      | —              | 5       | 3.0  | 6.5  | —   | MHz  |
|  |                                      |                | 10      | 6.0  | 18.0 | —   |      |
|  |                                      |                | 15      | 8.5  | 24.0 | —   |      |
| Min clock pulse width                      | t <sub>w</sub>                       | —              | 5       | —    | 80   | 180 | ns   |
|  |                                      |                | 10      | —    | 30   | 80  |      |
|  |                                      |                | 15      | —    | 20   | 50  |      |
| Max clock rise time<br>Max clock fall time | t <sub>rCL</sub><br>t <sub>fCL</sub> | —              | 5       | 20.0 | —    | —   | μs   |
|  |                                      |                | 10      | 2.5  | —    | —   |      |
|  |                                      |                | 15      | 1.0  | —    | —   |      |
| Min set-up time<br>(SI-CLOCK)              | t <sub>SU</sub>                      | —              | 5       | —    | 40   | 120 | ns   |
|  |                                      |                | 10      | —    | 20   | 80  |      |
|  |                                      |                | 15      | —    | 15   | 60  |      |
| Min set-up time<br>(PI-P/S)                | t <sub>SU</sub>                      | —              | 5       | —    | 25   | 50  | ns   |
|  |                                      |                | 10      | —    | 15   | 30  |      |
|  |                                      |                | 15      | —    | 10   | 20  |      |
| Min hold time<br>(SI-CLOCK), (PI-P/S)      | t <sub>H</sub>                       | —              | 5       | —    | 35   | 70  | ns   |
|  |                                      |                | 10      | —    | 20   | 40  |      |
|  |                                      |                | 15      | —    | 15   | 30  |      |
| Min pulse width<br>(P/S-CONTROL)           | t <sub>WH</sub>                      | —              | 5       | —    | 90   | 180 | ns   |
|  |                                      |                | 10      | —    | 30   | 80  |      |
|  |                                      |                | 15      | —    | 10   | 50  |      |
| Min removal time<br>(P/S-CLOCK)            | t <sub>rem</sub>                     | —              | 5       | —    | 45   | 280 | ns   |
|  |                                      |                | 10      | —    | 20   | 140 |      |
|  |                                      |                | 15      | —    | 15   | 100 |      |
| Input capacitance                          | C <sub>IN</sub>                      | —              |         | —    | 5    | 7.5 | pF   |

**Waveforms for Measurement of Dynamic Characteristics**

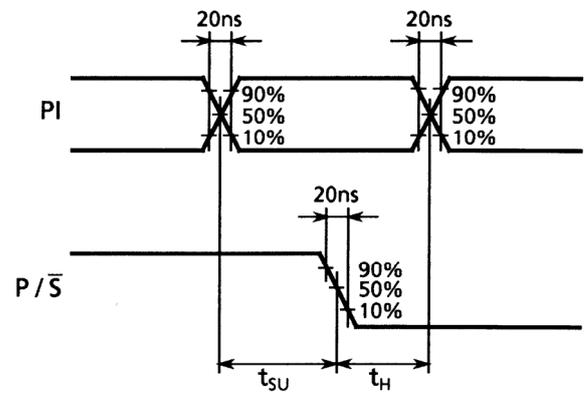
**Waveform 1**



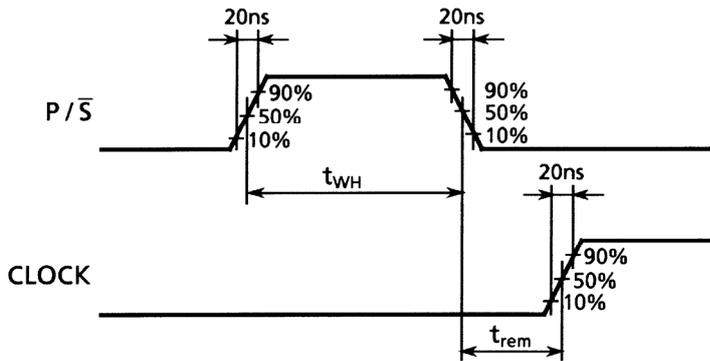
**Waveform 2**



**Waveform 3**



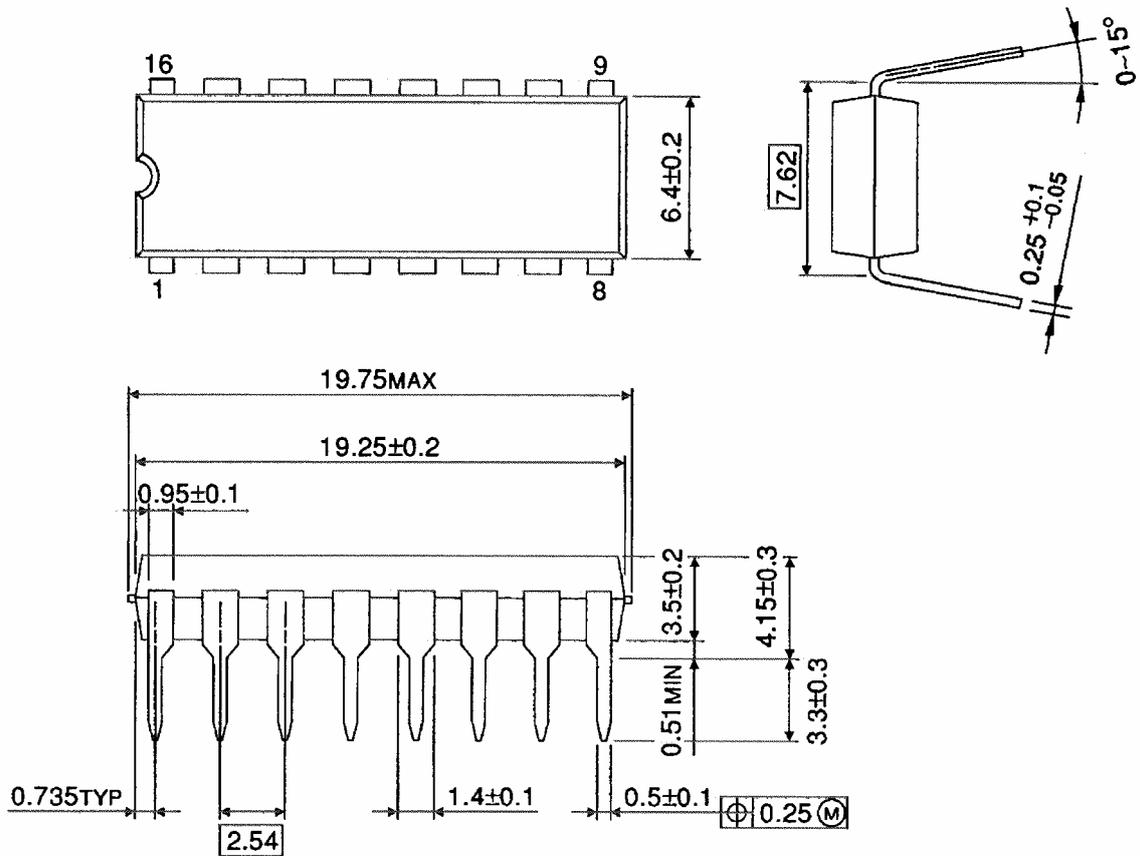
**Waveform 4**



## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

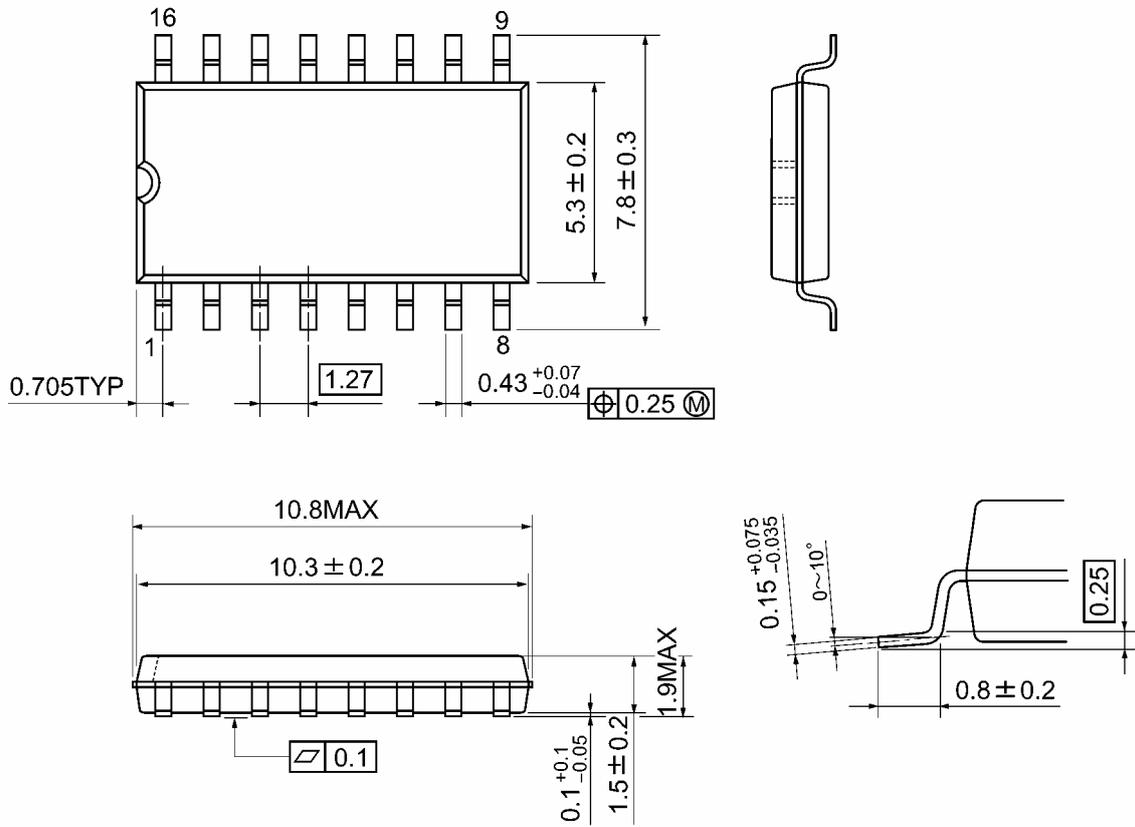


Weight: 1.00g (typ.)

**Package Dimensions**

SOP16-P-300-1.27A

Unit: mm

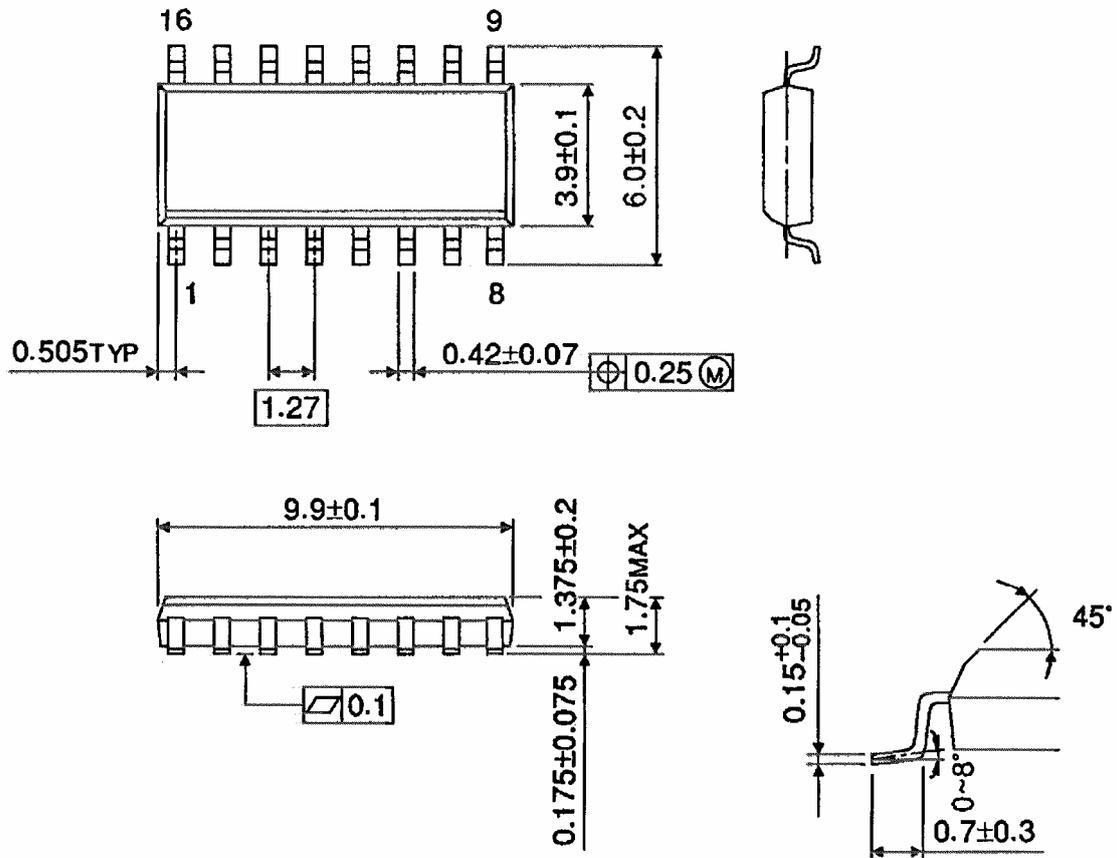


Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL16-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

Weight: 0.13 g (typ.)

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20070701-EN GENERAL

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