

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC4538BP, TC4538BF

TC4538BP/TC4538BF Dual Precision

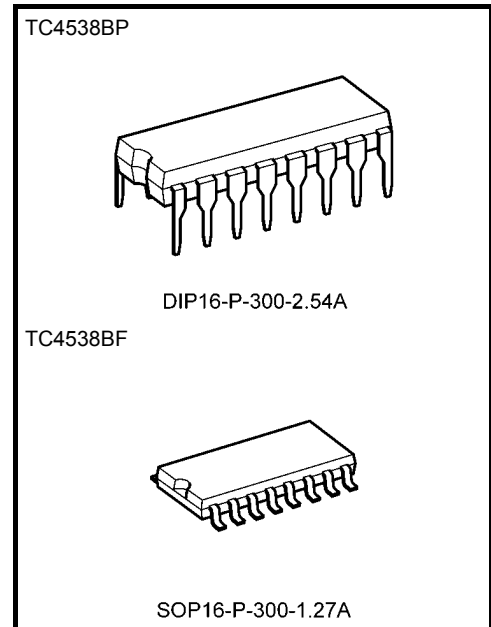
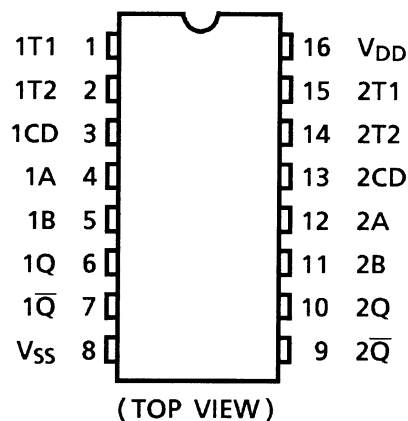
Retriggerable/Resetable Monostable Multivibrator

The TC4538BP/BF is the retriggerable/resetable monostable multivibrator and the trigger operation can be made at either the leading or trailing edge by 2 inputs of A and B. Since the output monostable pulse width is decided by time constant of the external resistor ( $R_X$ ) and the external capacitor ( $C_X$ ), it becomes possible to set a broad range of output pulse widths.

### Features

- $t_{wOUT} = 10 \text{ ms} \pm 5\%$  (at  $R_X = 100 \text{ k}\Omega$ ,  $C_X = 0.1 \text{ }\mu\text{F}$ ,  $V_{DD} = 10 \text{ V}$ )

### Pin Assignment



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

### Truth Table (Note)

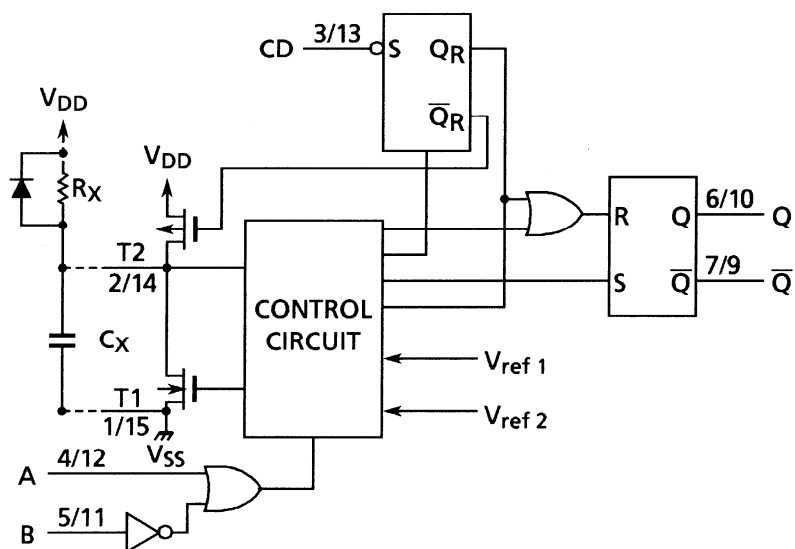
| Inputs |   |    | Outputs |           | Note          |
|--------|---|----|---------|-----------|---------------|
| A      | B | CD | Q       | $\bar{Q}$ |               |
|        | H | H  |         |           | Output Enable |
|        | L | H  | L       | H         | Inhibit       |
| H      |   | H  | L       | H         | Inhibit       |
| L      |   | H  |         |           | Output Enable |
| *      | * | L  | L       | H         | Inhibit       |

\*: Don't care

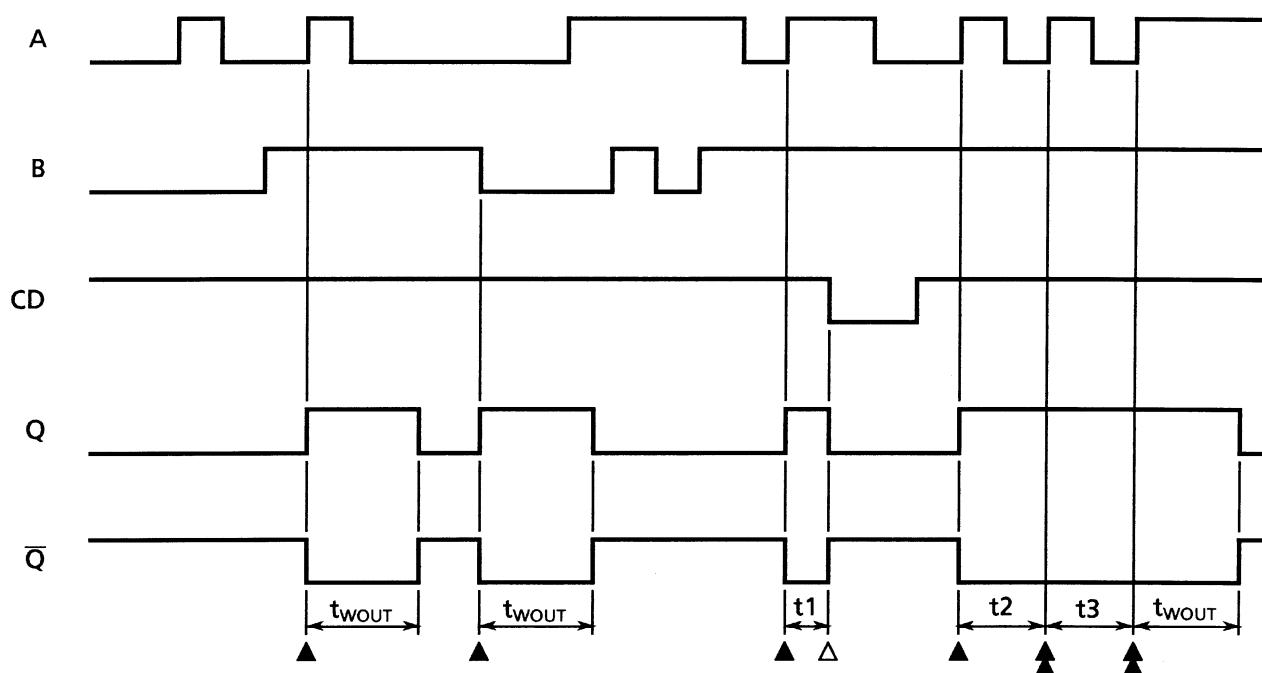
Note: In the case of using only one circuit, CD should be tied to GND,  $T_2$ ,  $T_1$ , Q,  $\bar{Q}$  should be tied to OPEN, and the other inputs should be tied to  $V_{CC}$  or GND.

## Logic Diagram

1/2 TC4538BP/BF



## Timing Chart



- ▲ : TRIGGER
- ▲▲ : RETRIGGER
- △ : RESET

$$t_{WOUT} = C_X \cdot R_X$$

$$t_1 \cdot t_2 \cdot t_3 ; \quad t_1 \cdot t_2 \cdot t_3 < t_{WOUT}$$

## Absolute Maximum Ratings (Note)

| Characteristics             | Symbol    | Rating                           | Unit |
|-----------------------------|-----------|----------------------------------|------|
| DC supply voltage           | $V_{DD}$  | $V_{SS} - 0.5$ to $V_{SS} + 20$  | V    |
| Input voltage               | $V_{IN}$  | $V_{SS} - 0.5$ to $V_{DD} + 0.5$ | V    |
| Output voltage              | $V_{OUT}$ | $V_{SS} - 0.5$ to $V_{DD} + 0.5$ | V    |
| DC input current            | $I_{IN}$  | $\pm 10$                         | mA   |
| Power dissipation           | $P_D$     | 300 (DIP)/180 (SOIC)             | mW   |
| Operating temperature range | $T_{opr}$ | -40 to 85                        | °C   |
| Storage temperature range   | $T_{stg}$ | -65 to 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          |
| External resistance  | $R_X$    | —              | 5         | —    | 1000     | k $\Omega$ |
| External capacitance | $C_X$    | —              | No limits |      |          | $\mu$ F    |

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 ( $V_{SS} = 0\text{ V}$ )

| Characteristics           | Sym-<br>bol | Test Condition                                                  | $V_{DD}$<br>(V)        | -40°C |      | 25°C  |       |            | 85°C  |      | Unit          |
|---------------------------|-------------|-----------------------------------------------------------------|------------------------|-------|------|-------|-------|------------|-------|------|---------------|
|                           |             |                                                                 |                        | Min   | Max  | Min   | Typ.  | Max        | Min   | Max  |               |
| High-level output voltage | $V_{OH}$    | $ I_{OUT}  < 1\text{ }\mu\text{A}$<br>$V_{IN} = V_{SS}, V_{DD}$ | 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  | $V_{OL}$    | $ I_{OUT}  < 1\text{ }\mu\text{A}$<br>$V_{IN} = V_{SS}, V_{DD}$ | 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       | $I_{OH}$    | $V_{OH} = 4.6\text{ V}$                                         | 5                      | -0.61 | —    | -0.51 | -1.0  | —          | -0.42 | —    | mA            |
|                           |             | $V_{OH} = 2.5\text{ V}$                                         | 5                      | -2.50 | —    | -2.10 | -4.0  | —          | -1.70 | —    |               |
|                           |             | $V_{OH} = 9.5\text{ V}$                                         | 10                     | -1.50 | —    | -1.30 | -2.2  | —          | -1.10 | —    |               |
|                           |             | $V_{OH} = 13.5\text{ V}$                                        | 15                     | -4.00 | —    | -3.40 | -9.0  | —          | -2.80 | —    |               |
|                           |             | $V_{IN} = V_{SS}, V_{DD}$                                       |                        |       |      |       |       |            |       |      |               |
| Output low current        | $I_{OL}$    | $V_{OL} = 0.4\text{ V}$                                         | 5                      | 0.61  | —    | 0.51  | 1.5   | —          | 0.42  | —    | mA            |
|                           |             | $V_{OL} = 0.5\text{ V}$                                         | 10                     | 1.50  | —    | 1.30  | 3.8   | —          | 1.10  | —    |               |
|                           |             | $V_{OL} = 1.5\text{ V}$                                         | 15                     | 4.00  | —    | 3.40  | 15.0  | —          | 2.80  | —    |               |
|                           |             | $V_{IN} = V_{SS}, V_{DD}$                                       |                        |       |      |       |       |            |       |      |               |
| Input high voltage        | $V_{IH}$    | $V_{OUT} = 0.5\text{ V}, 4.5\text{ V}$                          | 5                      | 3.5   | —    | 3.5   | 2.75  | —          | 3.5   | —    | V             |
|                           |             | $V_{OUT} = 1.0\text{ V}, 9.0\text{ V}$                          | 10                     | 7.0   | —    | 7.0   | 5.50  | —          | 7.0   | —    |               |
|                           |             | $V_{OUT} = 1.5\text{ V}, 13.5\text{ V}$                         | 15                     | 11.0  | —    | 11.0  | 8.25  | —          | 11.0  | —    |               |
|                           |             | $ I_{OUT}  < 1\text{ }\mu\text{A}$                              |                        |       |      |       |       |            |       |      |               |
| Input low voltage         | $V_{IL}$    | $V_{OUT} = 0.5\text{ V}, 4.5\text{ V}$                          | 5                      | —     | 1.5  | —     | 2.25  | 1.5        | —     | 1.5  | V             |
|                           |             | $V_{OUT} = 1.0\text{ V}, 9.0\text{ V}$                          | 10                     | —     | 3.0  | —     | 4.50  | 3.0        | —     | 3.0  |               |
|                           |             | $V_{OUT} = 1.5\text{ V}, 13.5\text{ V}$                         | 15                     | —     | 4.0  | —     | 6.75  | 4.0        | —     | 4.0  |               |
|                           |             | $ I_{OUT}  < 1\text{ }\mu\text{A}$                              |                        |       |      |       |       |            |       |      |               |
| Input current             | "H" level   | $I_{IH}$                                                        | $V_{IH} = 18\text{ V}$ | 18    | —    | 0.1   | —     | $10^{-5}$  | 0.1   | —    | $\mu\text{A}$ |
|                           | "L" level   | $I_{IL}$                                                        | $V_{IL} = 0\text{ V}$  | 18    | —    | -0.1  | —     | $-10^{-5}$ | -0.1  | —    |               |
| Quiescent supply current  | $I_{DD}$    | $V_{IN} = V_{SS}, V_{DD}$<br>(Note)                             | 5                      | —     | 5    | —     | 0.005 | 5          | —     | 150  | $\mu\text{A}$ |
|                           |             |                                                                 | 10                     | —     | 10   | —     | 0.010 | 10         | —     | 300  |               |
|                           |             |                                                                 | 15                     | —     | 20   | —     | 0.015 | 20         | —     | 600  |               |

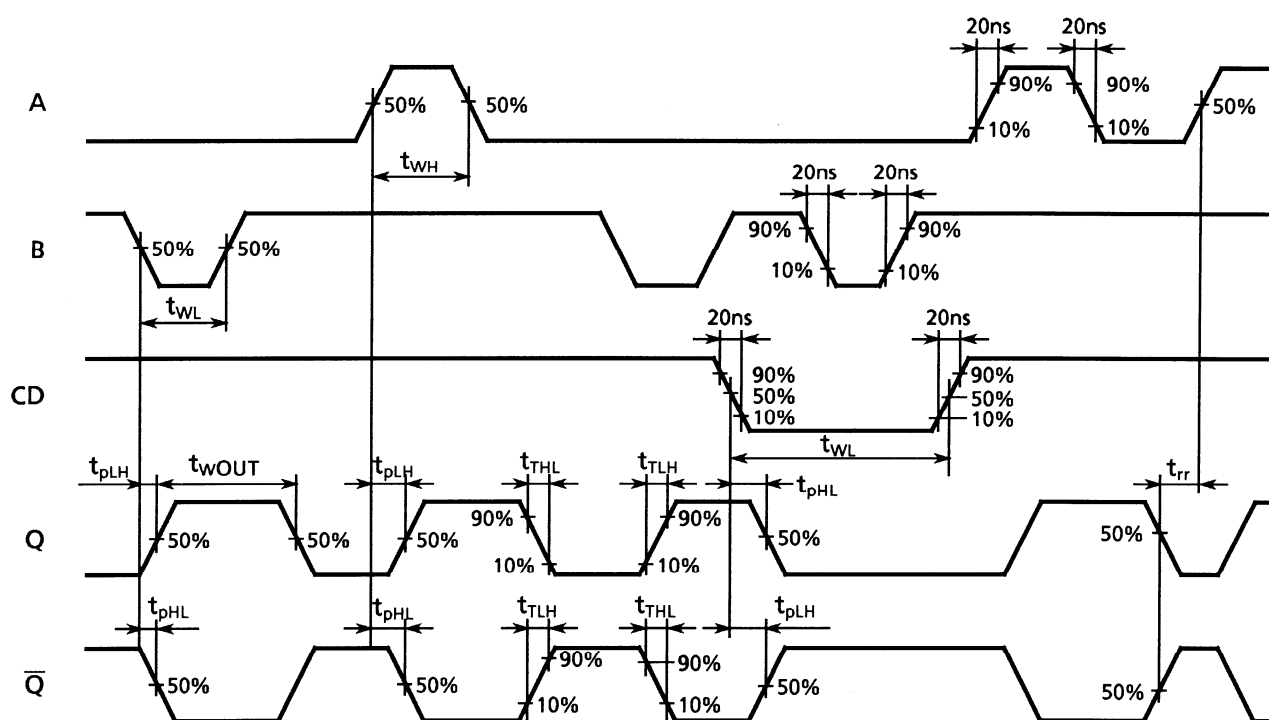
Note: All valid input combinations.

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 |
|-----------------------------------------------------------|--------------------------------------|----------------------------------------------------------|---------------------|------|-------|-------|------|
|                                                           |                                      |                                                          |                     |      |       |       |      |
| 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>(A, B-Q, $\overline{Q}$ )       | t <sub>pLH</sub><br>t <sub>pHL</sub> | —                                                        | 5                   | —    | 380   | 760   | ns   |
|                                                           |                                      |                                                          | 10                  | —    | 150   | 300   |      |
|                                                           |                                      |                                                          | 15                  | —    | 100   | 220   |      |
| Propagation delay time<br>(CD-Q, $\overline{Q}$ )         | t <sub>pLH</sub><br>t <sub>pHL</sub> | —                                                        | 5                   | —    | 280   | 560   | ns   |
|                                                           |                                      |                                                          | 10                  | —    | 110   | 250   |      |
|                                                           |                                      |                                                          | 15                  | —    | 75    | 190   |      |
| Min input pulse width<br>(A, B)                           | t <sub>WH</sub><br>t <sub>WL</sub>   | —                                                        | 5                   | —    | 60    | 120   | ns   |
|                                                           |                                      |                                                          | 10                  | —    | 30    | 60    |      |
|                                                           |                                      |                                                          | 15                  | —    | 25    | 50    |      |
| Min pulse width<br>(CD)                                   | t <sub>WL</sub>                      | —                                                        | 5                   | —    | 95    | 190   | ns   |
|                                                           |                                      |                                                          | 10                  | —    | 45    | 90    |      |
|                                                           |                                      |                                                          | 15                  | —    | 35    | 70    |      |
| Min retrigger time                                        | t <sub>rr</sub>                      | —                                                        | 5                   | —    | 0     | —     | ns   |
|                                                           |                                      |                                                          | 10                  | —    | 0     | —     |      |
|                                                           |                                      |                                                          | 15                  | —    | 0     | —     |      |
| Output pulse width                                        | t <sub>wOUT</sub>                    | R <sub>X</sub> = 100 kΩ<br>C <sub>X</sub> = 0.002 μF     | 5                   | —    | 206   | —     | μs   |
|                                                           |                                      |                                                          | 10                  | —    | 204   | —     |      |
|                                                           |                                      |                                                          | 15                  | —    | 205   | —     |      |
|                                                           |                                      | R <sub>X</sub> = 100 kΩ<br>C <sub>X</sub> = 0.1 μF       | 5                   | 9.30 | 9.95  | 10.40 | ms   |
|                                                           |                                      |                                                          | 10                  | 9.50 | 10.00 | 10.50 |      |
|                                                           |                                      |                                                          | 15                  | 9.55 | 10.05 | 10.65 |      |
|                                                           |                                      | R <sub>X</sub> = 100 kΩ<br>C <sub>X</sub> = 10 μF        | 5                   | —    | 0.98  | —     | s    |
|                                                           |                                      |                                                          | 10                  | —    | 1.00  | —     |      |
|                                                           |                                      |                                                          | 15                  | —    | 1.01  | —     |      |
| Pulse width match between circuits in<br>the same package | Δt <sub>wOUT</sub>                   | $\frac{t_{wOUT}(Q2) - t_w(Q1)}{t_{wOUT}(Q1)} \times 100$ | 5                   | —    | ±1    | —     | %    |
|                                                           |                                      |                                                          | 10                  | —    | ±1    | —     |      |
|                                                           |                                      |                                                          | 15                  | —    | ±1    | —     |      |
| Input capacitance                                         | C <sub>IN</sub>                      | —                                                        | —                   | —    | 5     | 7.5   | pF   |

## Waveform for Measurement of Dynamic Characteristics

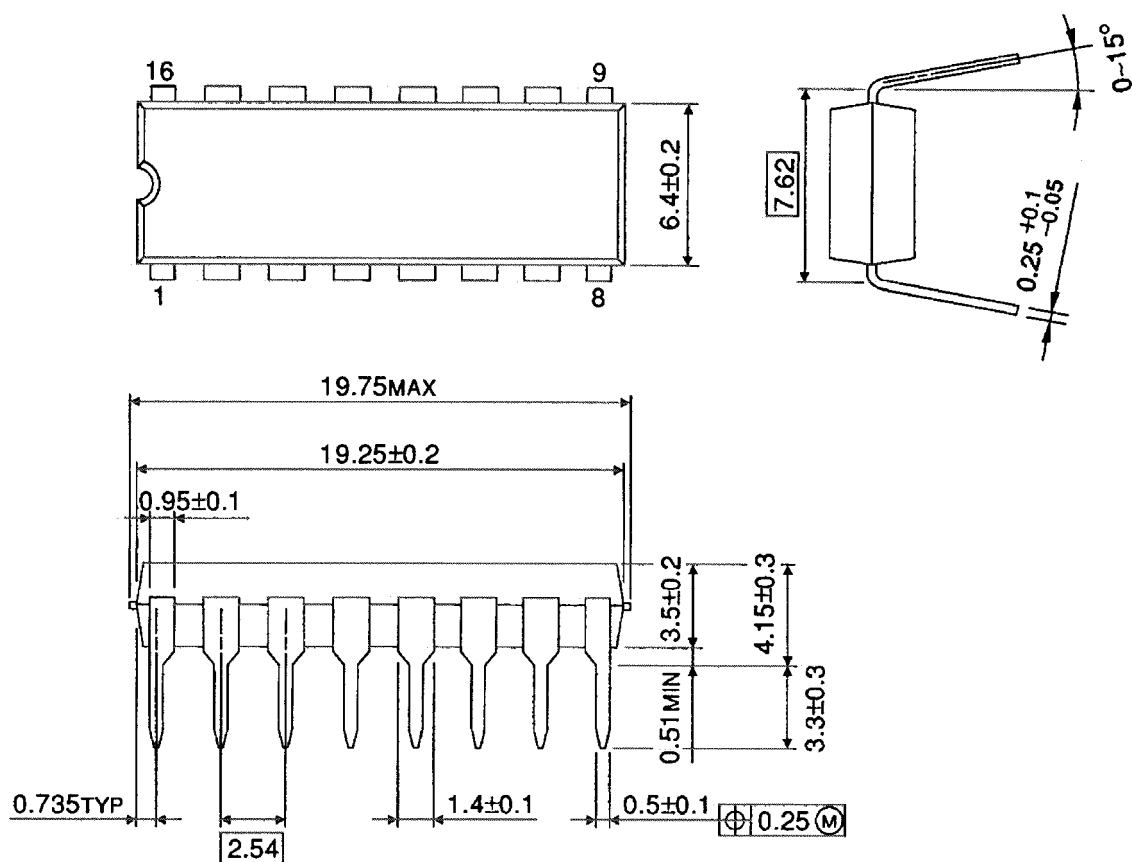
### Waveform



## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

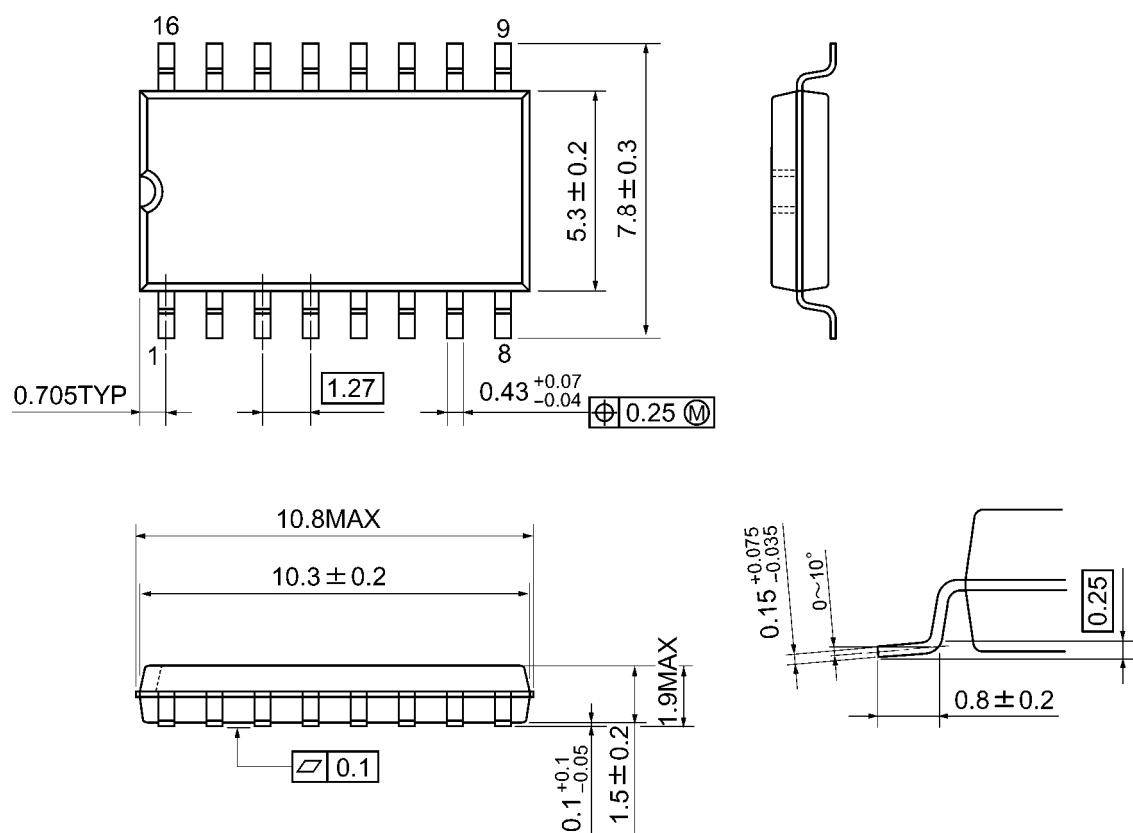


Weight: 1.00 g (typ.)

## Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)



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