TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC4017BP,TC4017BF

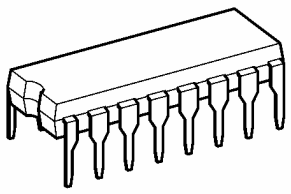
TC4017BP/TC4017BF Decade Counter/Divider

TC4017BP/BF is decimal Johnson counter consisting of 5 stage D-type flip-flop equipped with the decoder to convert the output to decimal.

Depending on the number of count pulses fed to CLOCK or CLOCK INHIBIT one output among 10 output lines “Q0” through “Q9” becomes “H” level.

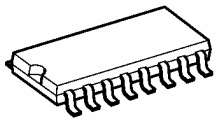
The counter advances its state at rising edge of CLOCK (CLOCK INHIBIT = “L”) or falling edge of CLOCK INHIBIT (CLOCK = “H”). RESET input to “H” level resets the counter to Q0 = “H” and Q1 through Q9 = “L” regardless of CLOCK and CLOCK INHIBIT.

TC4017BP

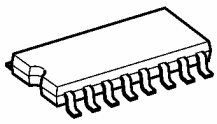


DIP16-P-300-2.54A

TC4017BF



SOP16-P-300-1.27A

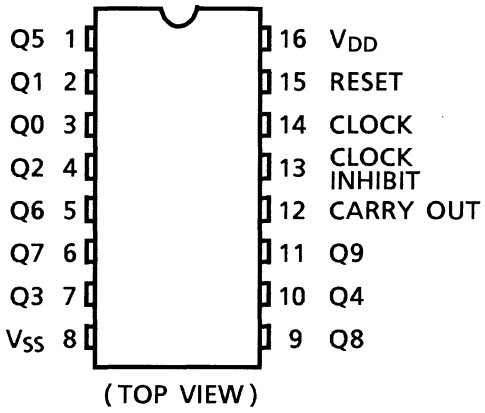


SOP16-P-300-1.27

Weight

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

## Pin Assignment




## Truth Table

| Inputs | | | Selected Output |
|---|---|---|---|
| CLOCK∆ | CLOCK INHIBIT∆ | RESET | |
| * | * | H | Q0 |
| * | H | L | Qn (NC) |
| L | * | L | Qn (NC) |
| ↑ | L | L | Qn + 1 |
| ↓ | L | L | Qn (NC) |
| H | ↑ | L | Qn (NC) |
| H | ↓ | L | Qn + 1 |

∆: Level change

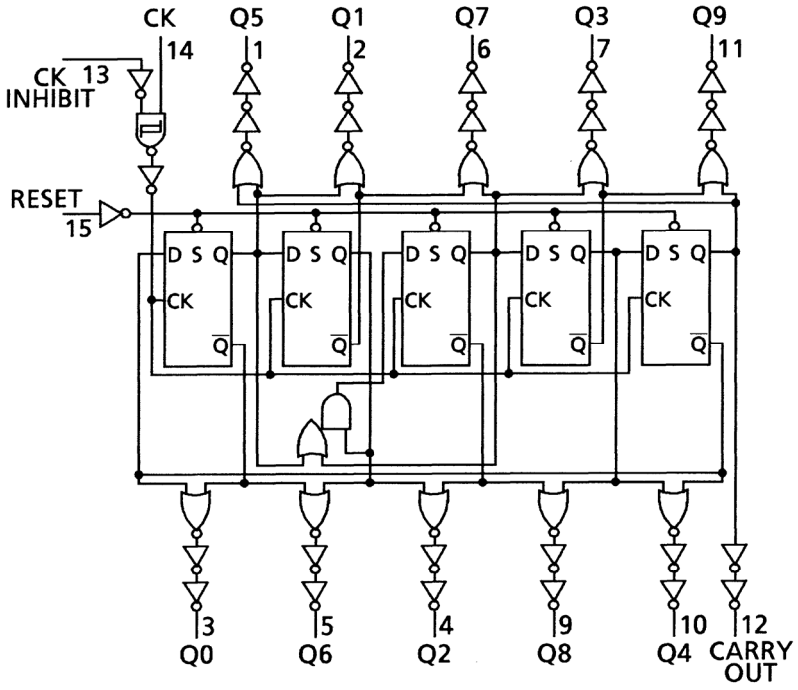
*: Don’t care

NC: No change

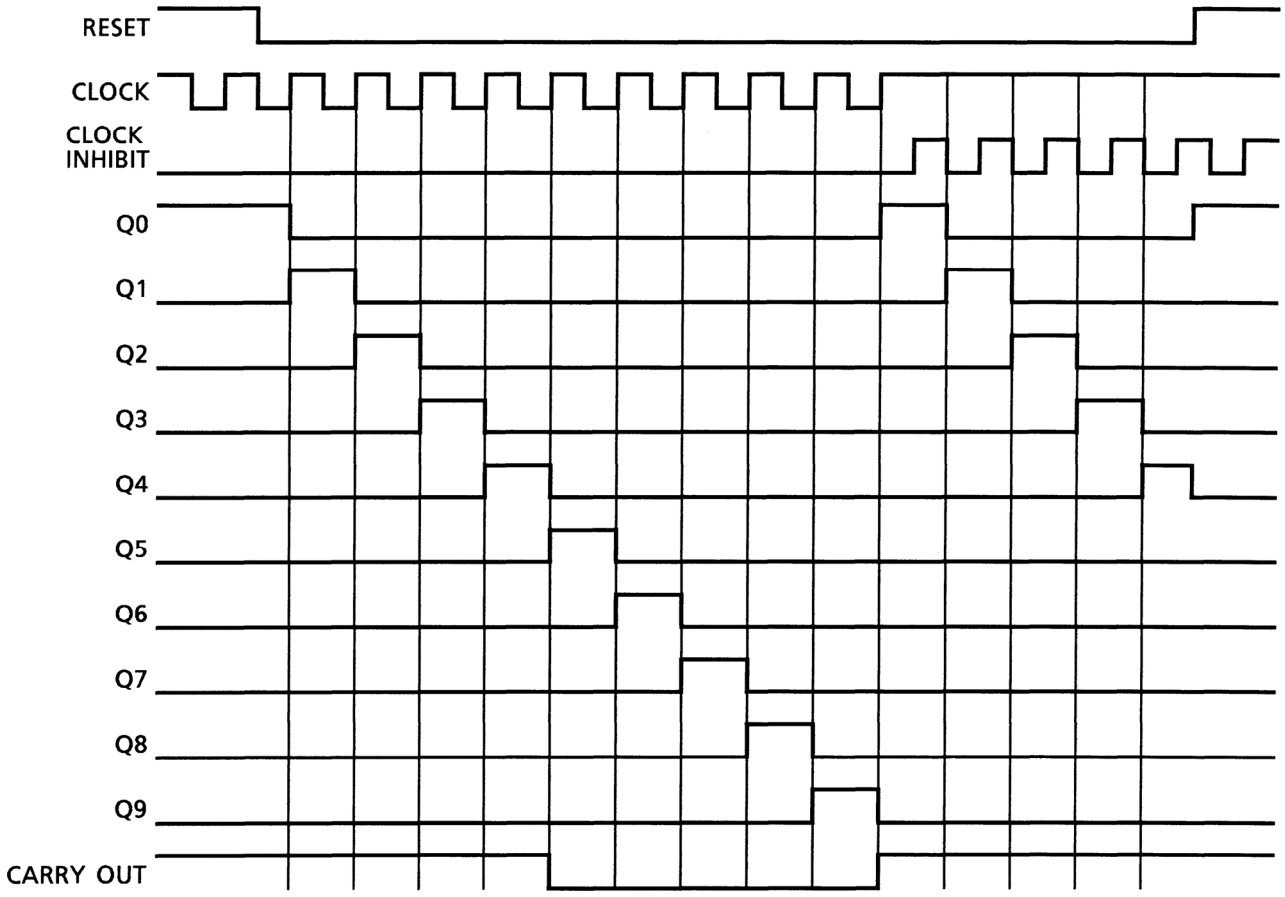
carry out “H”..... Q0~Q4 = “H”

“L” ..... Q5~Q9 = “H”

## Logic Diagram




## Timing Chart



## 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 ambient 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.

## Recommended Operating Conditions ($V_{SS}$ = 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 recommended operating conditions are required to ensure the normal operation of the device. Unused inputs must be tied to either VCC or GND.

## Static Electrical Characteristics ($V_{SS}$ = 0 V)

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

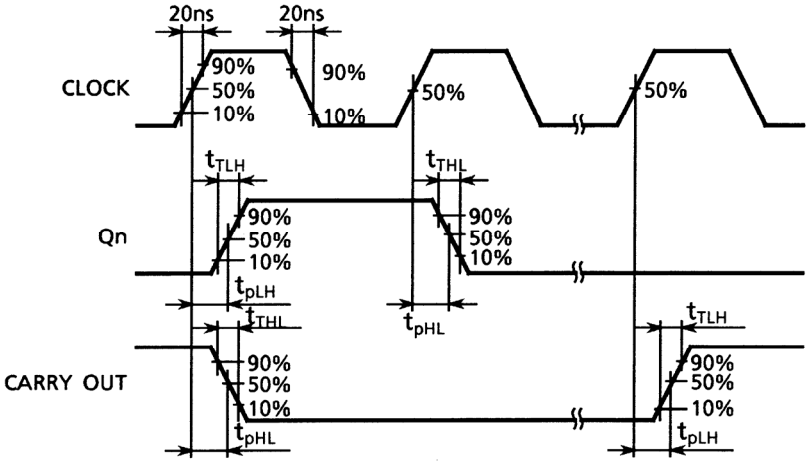
Note: All valid input combinations.

## Dynamic Electrical Characteristics (Ta = 25°C, $V_{SS}$ = 0 V, $C_L$ = 50 pF)

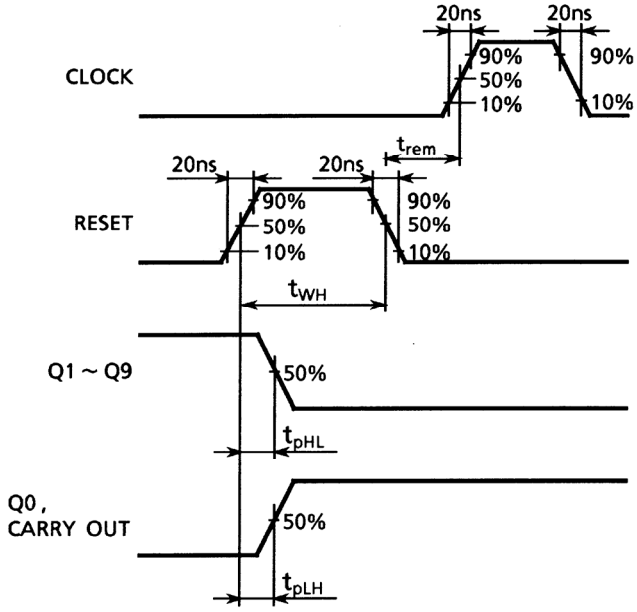
| Characteristics | Symbol | Test Condition | $V_{DD}$ (V) | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Output transition time (low to high) | $t_{TLH}$ | — | 5 | — | 80 | 200 | ns |
| | | | 10 | — | 50 | 100 | |
| | | | 15 | — | 40 | 80 | |
| Output transition time (high to low) | $t_{THL}$ | — | 5 | — | 80 | 200 | ns |
| | | | 10 | — | 50 | 100 | |
| | | | 15 | — | 40 | 80 | |
| Propagation delay time (CLOCK-Qn) | $t_{pLH}$ $t_{pHL}$ | — | 5 | — | 325 | 650 | ns |
| | | | 10 | — | 135 | 270 | |
| | | | 15 | — | 85 | 170 | |
| Propagation delay time (CLOCK-CARRY OUT) | $t_{pLH}$ $t_{pHL}$ | — | 5 | — | 280 | 600 | ns |
| | | | 10 | — | 110 | 250 | |
| | | | 15 | — | 75 | 160 | |
| Propagation delay time (RESET-Qn, RESET-CARRY OUT) | $t_{pLH}$ $t_{pHL}$ | — | 5 | — | 265 | 530 | ns |
| | | | 10 | — | 115 | 230 | |
| | | | 15 | — | 85 | 170 | |
| Max clock frequency | $f_{CL}$ | — | 5 | 2.5 | 6.0 | — | MHz |
| | | | 10 | 5.0 | 12.0 | — | |
| | | | 15 | 6.7 | 13.5 | — | |
| Min clock pulse width | $t_W$ | — | 5 | — | 85 | 200 | ns |
| | | | 10 | — | 40 | 90 | |
| | | | 15 | — | 35 | 60 | |
| Min pulse width (RESET) | $t_{WH}$ | — | 5 | — | 50 | 260 | ns |
| | | | 10 | — | 20 | 110 | |
| | | | 15 | — | 15 | 60 | |
| Max clock rise time Max clock fall time | $t_{rCL}$ $t_{fCL}$ | — | 5 | No limit | | | μs |
| | | | 10 | | | | |
| | | | 15 | | | | |
| Min set-up time (CLOCK INHIBIT-CLOCK) | $t_{SU}$ | — | 5 | — | 30 | 230 | ns |
| | | | 10 | — | 15 | 100 | |
| | | | 15 | — | 10 | 70 | |
| Min removal time (RESET-CLOCK) | $t_{rem}$ | — | 5 | — | −55 | 400 | ns |
| | | | 10 | — | −20 | 275 | |
| | | | 15 | — | −15 | 150 | |
| Input capacitance | $C_{IN}$ | — | | — | 5 | 7.5 | pF |

## Waveforms for Measurement of Dynamic Characteristics

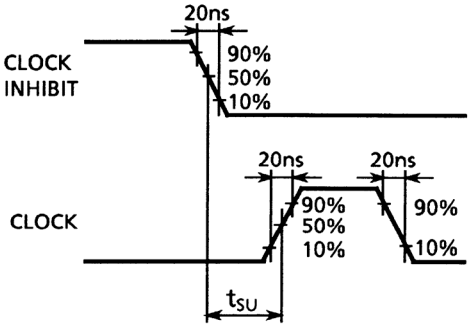
### Waveform 1




### Waveform 2

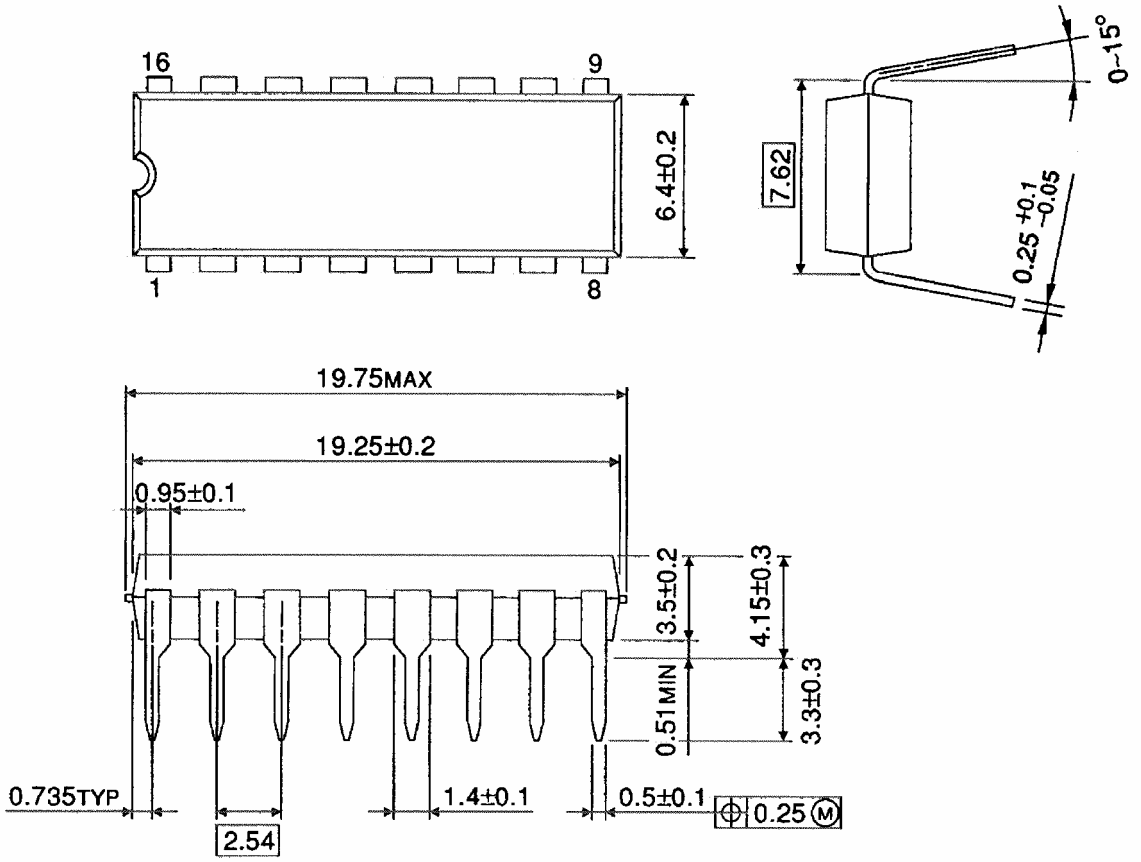



### Waveform 3



## Package Dimensions

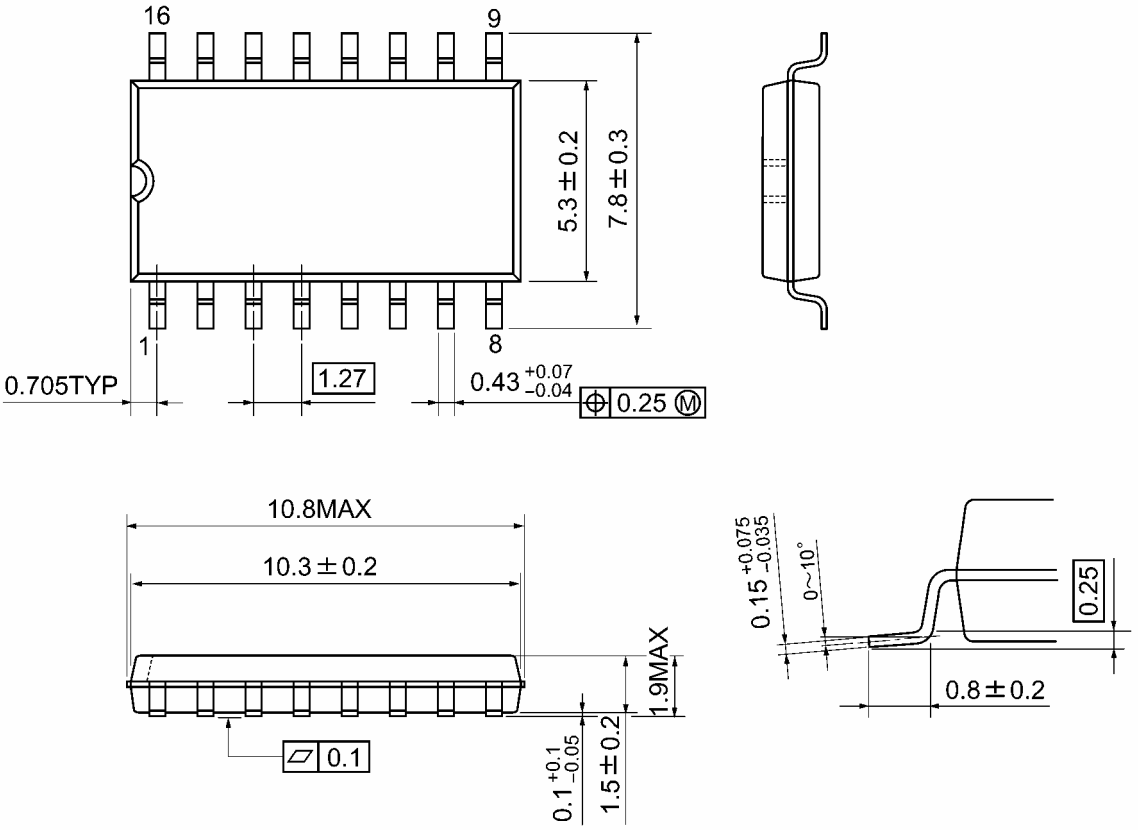
DIP16-P-300-2.54A Unit : mm




Weight: 1.00 g (typ.)

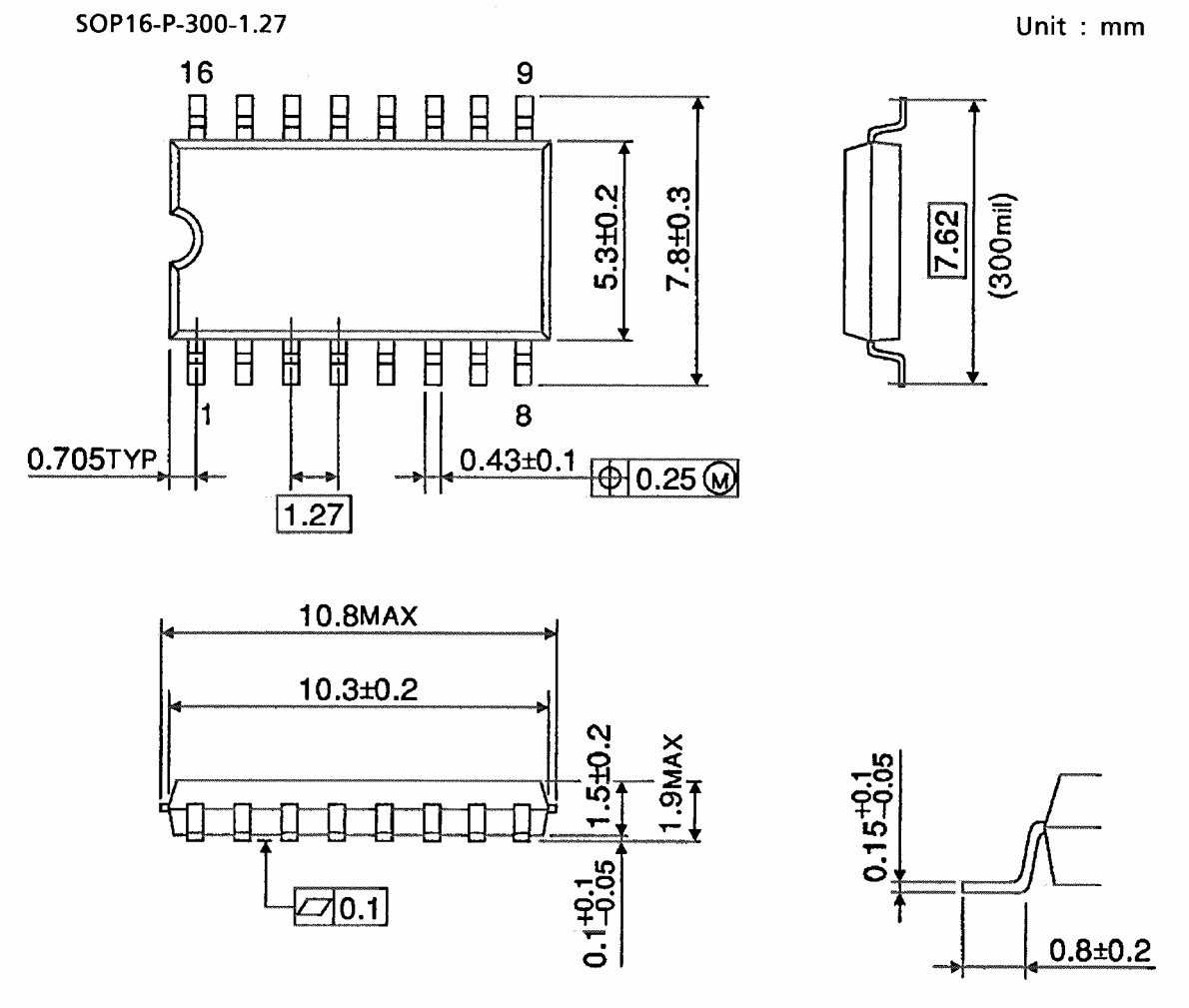
## Package Dimensions

SOP16-P-300-1.27A Unit: mm




Weight: 0.18 g (typ.)

## Package Dimensions




Weight: 0.18 g (typ.)

**Note: Lead (Pb)-Free Packages**

**DIP16-P-300-2.54A SOP16-P-300-1.27A**

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20070701-EN

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