TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

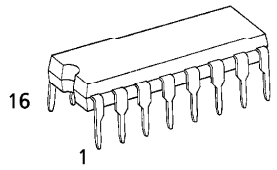
# TC4021BP, TC4021BF, TC4021BFN

## TC4021B 8 – STAGE STATIC SHIFT REGISTER (ASYNCHRONOUS PARALLEL INPUT OR SYNCHRONOUS SERIAL INPUT / SERIAL OUTPUT)

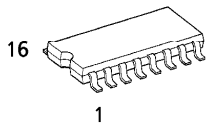
TC4021B is 8 stage parallel in / serial out shift register, which can be used also for serial in / serial out operations. In the case of parallel operation, the data of PARALLEL IN is input to each F / F asynchronously with CLOCK and the output is obtained. In the case of serial operations, each F / 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 / $\overline{S}$ CONTROL input. When P / $\overline{S}$ CONTROL input is "H", PARALLEL operation is designated and when it is "L", SERIAL operation is designated.

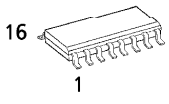
(Note) The JEDEC SOP (FN) is not available in Japan.




P (DIP16-P-300-2.54A)
Weight : 1.00g (Typ.)




F (SOP16-P-300-1.27)
Weight : 0.18g (Typ.)




FN (SOL16-P-150-1.27)
Weight : 0.13g (Typ.)

### MAXIMUM RATINGS

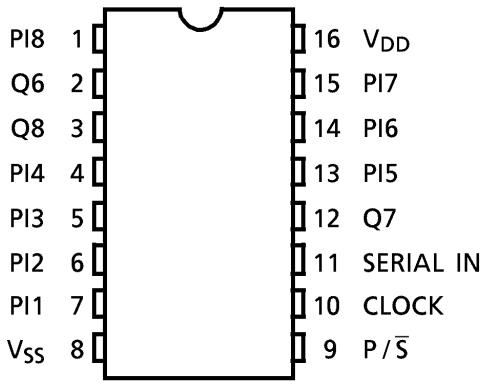
| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|---|---|---|---|
| DC Supply Voltage | $V_{DD}$ | $V_{SS}-0.5 \sim V_{SS}+20$ | V |
| Input Voltage | $V_{IN}$ | $V_{SS}-0.5 \sim V_{DD}+0.5$ | V |
| Output Voltage | $V_{OUT}$ | $V_{SS}-0.5 \sim V_{DD}+0.5$ | V |
| DC Input Current | $I_{IN}$ | ± 10 | mA |
| 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 |

### TRUTH TABLE

| INPUTS | | | | | OUTPUTS△ | |
|---|---|---|---|---|---|---|
| CLOCK △△ | P / $\overline{S}$ | PI1 | PIn | SI | Q1 | Qn |
| ↑ | L | ※ | ※ | L | L | Qn - 1 |
| ↑ | L | ※ | ※ | H | H | Qn - 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
△ : Q1 ~ Q5 Internal
△△ : Level Change
※ : Don't Care

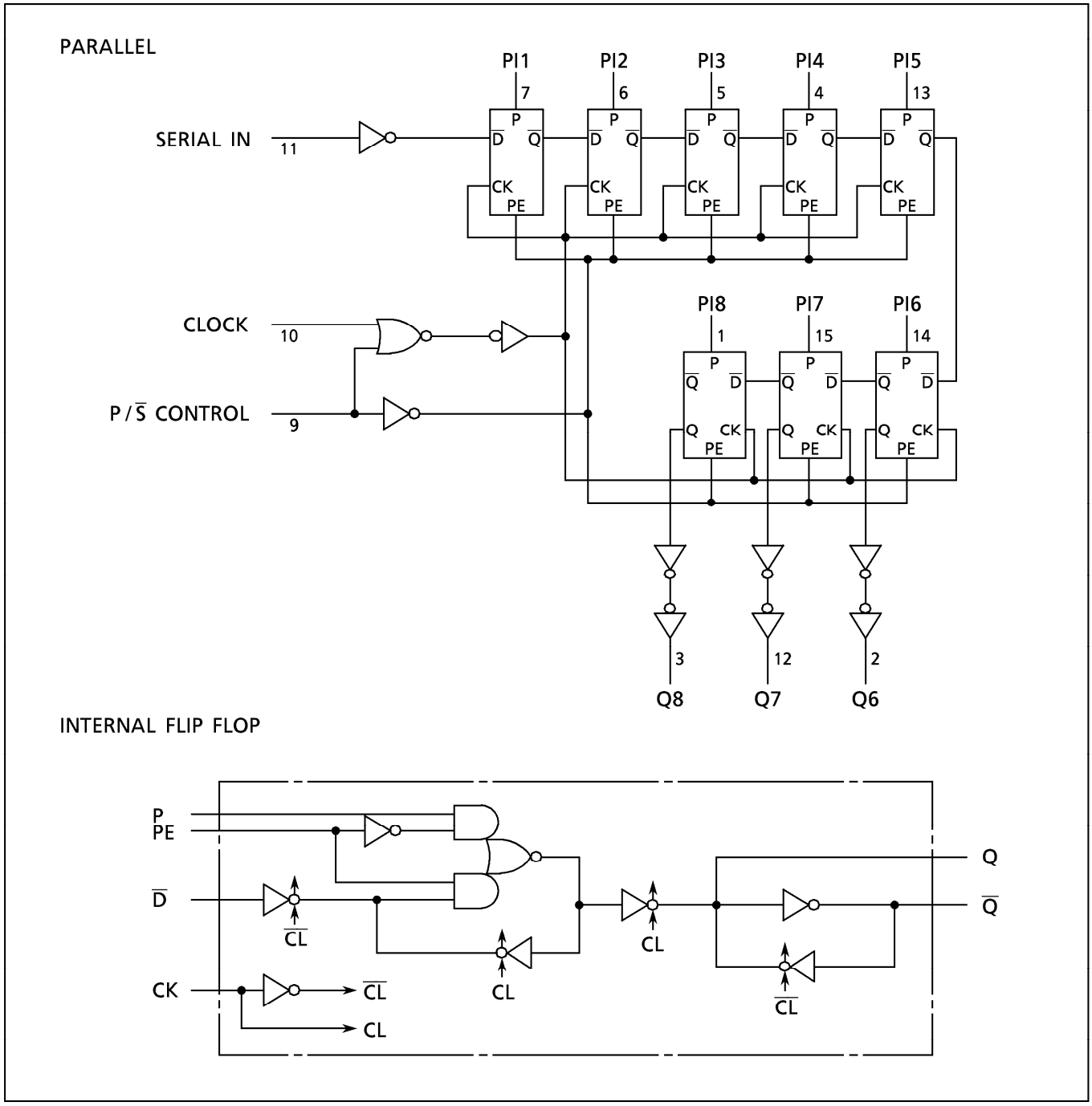
### PIN ASSIGNMENT




(TOP VIEW)

961001EBA2

## LOGIC DIAGRAM



**RECOMMENDED OPERATING CONDITIONS ($V_{SS}$ = 0V)**

| CHARACTERISTIC | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| DC Supply Voltage | $V_{DD}$ | | 3 | — | 18 | V |
| Input Voltage | $V_{IN}$ | | 0 | — | $V_{DD}$ | V |

**STATIC ELECTRICAL CHARACTERISTICS ($V_{SS}$ = 0V)**

| CHARACTERISTIC | SYMBOL | TEST CONDITION | $V_{DD}$ (V) | −40°C MIN. | −40°C MAX. | 25°C MIN. | 25°C TYP. | 25°C MAX. | 85°C MIN. | 85°C MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| High-Level Output Voltage | $V_{OH}$ | $\|I_{OUT}\| < 1\mu A$, $V_{IN} = V_{SS}, V_{DD}$ | 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 | $V_{OL}$ | $\|I_{OUT}\| < 1\mu A$, $V_{IN} = V_{SS}, V_{DD}$ | 5 | — | 0.05 | — | 0.00 | 0.05 | — | 0.05 | |
| | | | 10 | — | 0.05 | — | 0.00 | 0.05 | — | 0.05 | |
| | | | 15 | — | 0.05 | — | 0.00 | 0.05 | — | 0.05 | |
| Output High Current | $I_{OH}$ | $V_{OH}$ = 4.6V | 5 | −0.61 | — | −0.51 | −1.0 | — | −0.42 | — | mA |
| | | $V_{OH}$ = 2.5V | 5 | −2.50 | — | −2.10 | −4.0 | — | −1.70 | — | |
| | | $V_{OH}$ = 9.5V | 10 | −1.50 | — | −1.30 | −2.2 | — | −1.10 | — | |
| | | $V_{OH}$ = 13.5V | 15 | −4.00 | — | −3.40 | −9.0 | — | −2.80 | — | |
| | | $V_{IN} = V_{SS}, V_{DD}$ | | | | | | | | | |
| Output Low Current | $I_{OL}$ | $V_{OL}$ = 0.4V | 5 | 0.61 | — | 0.51 | 1.5 | — | 0.42 | — | |
| | | $V_{OL}$ = 0.5V | 10 | 1.50 | — | 1.30 | 3.8 | — | 1.10 | — | |
| | | $V_{OL}$ = 1.5V | 15 | 4.00 | — | 3.40 | 15.0 | — | 2.80 | — | |
| | | $V_{IN} = V_{SS}, V_{DD}$ | | | | | | | | | |
| Input High Voltage | $V_{IH}$ | $V_{OUT}$ = 0.5V, 4.5V | 5 | 3.5 | — | 3.5 | 2.75 | — | 3.5 | — | V |
| | | $V_{OUT}$ = 1.0V, 9.0V | 10 | 7.0 | — | 7.0 | 5.50 | — | 7.0 | — | |
| | | $V_{OUT}$ = 1.5V, 13.5V | 15 | 11.0 | — | 11.0 | 8.25 | — | 11.0 | — | |
| | | $\|I_{OUT}\| < 1\mu A$ | | | | | | | | | |
| Input Low Voltage | $V_{IL}$ | $V_{OUT}$ = 0.5V, 4.5V | 5 | — | 1.5 | — | 2.25 | 1.5 | — | 1.5 | |
| | | $V_{OUT}$ = 1.0V, 9.0V | 10 | — | 3.0 | — | 4.50 | 3.0 | — | 3.0 | |
| | | $V_{OUT}$ = 1.5V, 13.5V | 15 | — | 4.0 | — | 6.75 | 4.0 | — | 4.0 | |
| | | $\|I_{OUT}\| < 1\mu A$ | | | | | | | | | |
| Input Current "H" Level | $I_{IH}$ | $V_{IH}$ = 18V | 18 | — | 0.1 | — | $10^{-5}$ | 0.1 | — | 1.0 | μA |
| Input Current "L" Level | $I_{IL}$ | $V_{IL}$ = 0V | 18 | — | −0.1 | — | $-10^{-5}$ | −0.1 | — | −1.0 | |
| Quiescent Supply Current | $I_{DD}$ | $V_{IN} = V_{SS}, V_{DD}$ * | 5 | — | 5 | — | 0.005 | 5 | — | 150 | μA |
| | | | 10 | — | 10 | — | 0.010 | 10 | — | 300 | |
| | | | 15 | — | 20 | — | 0.020 | 20 | — | 600 | |

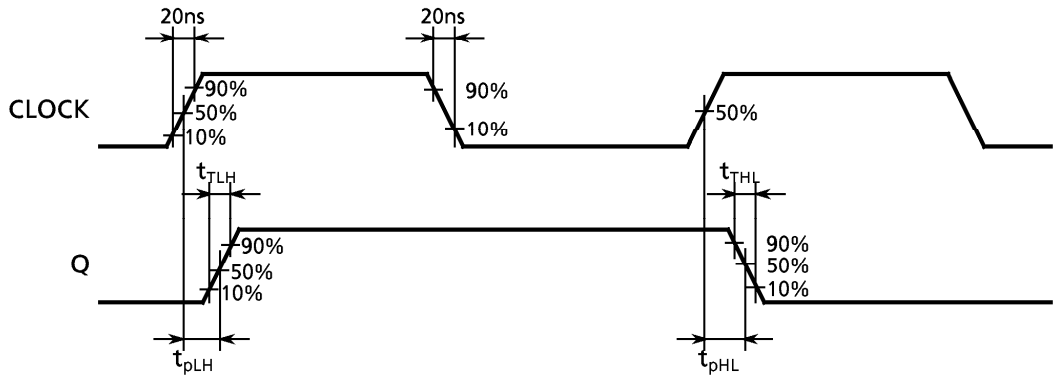
* All valid input combinations.

**DYNAMIC ELECTRICAL CHARACTERISTICS (Ta = 25°C, Vss = 0V, $C_L$ = 50pF)**

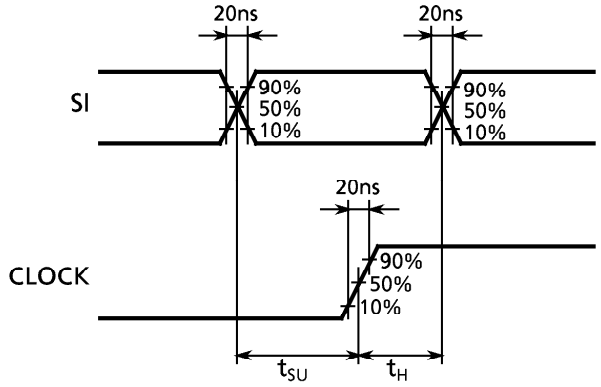
| CHARACTERISTIC | SYMBOL | TEST CONDITION $V_{DD}$(V) | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Output Transition Time (Low to High) | $t_{TLH}$ | 5 | — | 80 | 200 | ns |
| | | 10 | — | 50 | 100 | |
| | | 15 | — | 40 | 80 | |
| Output Transition Time (High to Low) | $t_{THL}$ | 5 | — | 80 | 200 | |
| | | 10 | — | 50 | 100 | |
| | | 15 | — | 40 | 80 | |
| Propagation Delay Time (CLOCK - Q) | $t_{pLH}$ $t_{pHL}$ | 5 | — | 150 | 320 | ns |
| | | 10 | — | 65 | 160 | |
| | | 15 | — | 45 | 120 | |
| Propagation Delay Time (P / $\overline{S}$ - Q) | $t_{pLH}$ $t_{pHL}$ | 5 | — | 230 | 460 | ns |
| | | 10 | — | 90 | 180 | |
| | | 15 | — | 60 | 120 | |
| Max. Clock Frequency | $f_{CL}$ | 5 | 3.0 | 6.5 | — | MHz |
| | | 10 | 6.0 | 18.0 | — | |
| | | 15 | 8.5 | 24.0 | — | |
| Min. Clock Pulse Width | $t_W$ | 5 | — | 80 | 180 | ns |
| | | 10 | — | 30 | 80 | |
| | | 15 | — | 20 | 50 | |
| Max. Clock Rise Time Max. Clock Fall Time | $t_{rCL}$ $t_{fCL}$ | 5 | 20.0 | — | — | μs |
| | | 10 | 2.5 | — | — | |
| | | 15 | 1.0 | — | — | |
| Min. Set – up Time (SI - CLOCK) | $t_{SU}$ | 5 | — | 40 | 120 | ns |
| | | 10 | — | 20 | 80 | |
| | | 15 | — | 15 | 60 | |
| Min. Set – up Time (PI - P / $\overline{S}$) | $t_{SU}$ | 5 | — | 25 | 50 | ns |
| | | 10 | — | 15 | 30 | |
| | | 15 | — | 10 | 20 | |
| Min. Hold Time (SI - CLOCK), (PI - P / $\overline{S}$) | $t_H$ | 5 | — | 35 | 70 | ns |
| | | 10 | — | 20 | 40 | |
| | | 15 | — | 15 | 30 | |
| Min. Pulse Width (P / $\overline{S}$ – CONTROL) | $t_{WH}$ | 5 | — | 90 | 180 | ns |
| | | 10 | — | 30 | 80 | |
| | | 15 | — | 10 | 50 | |
| Min. Removal Time (P / $\overline{S}$ - CLOCK) | $t_{rem}$ | 5 | — | 45 | 280 | ns |
| | | 10 | — | 20 | 140 | |
| | | 15 | — | 15 | 100 | |
| Input Capacitance | $C_{IN}$ | | — | 5 | 7.5 | pF |

## WAVEFORMS FOR MEASUREMENT OF DYNAMIC CHARACTERISTICS

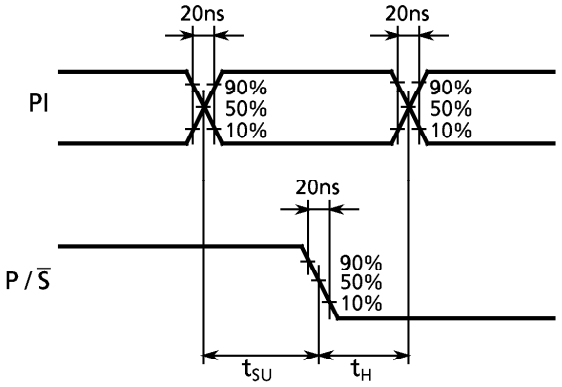
WAVEFORM 1



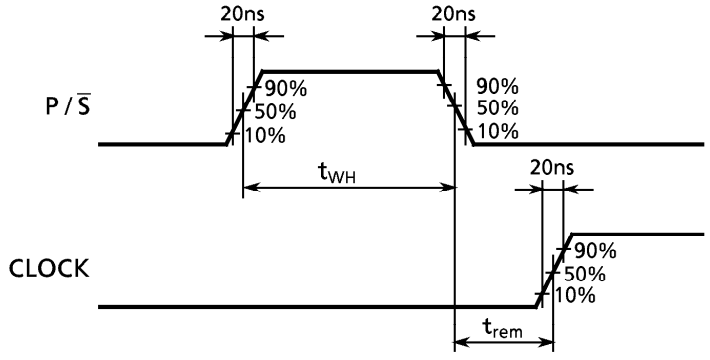

WAVEFORM 2



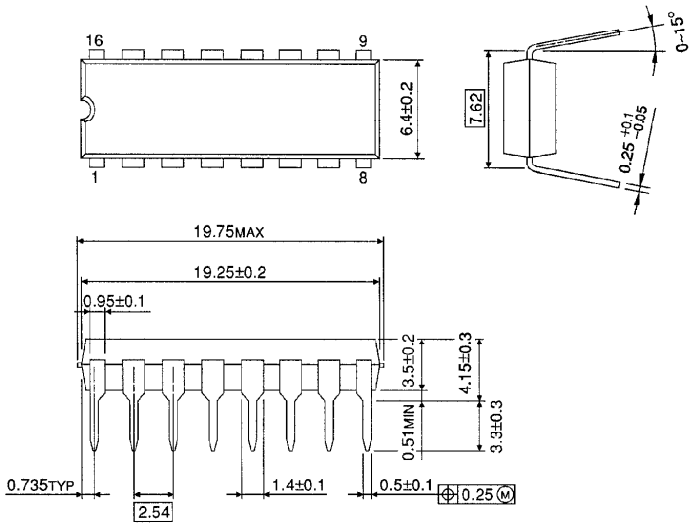

WAVEFORM 3




WAVEFORM 4

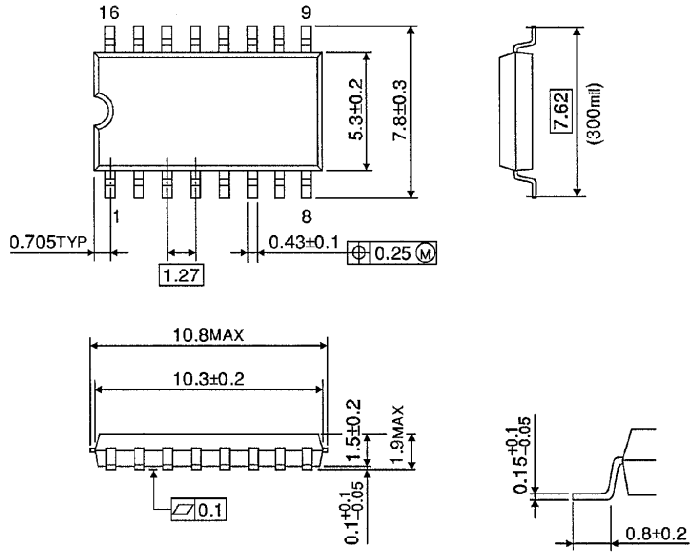


**DIP 16PIN OUTLINE DRAWING (DIP16-P-300-2.54A)** Unit in mm




Weight : 1.00g (Typ.)

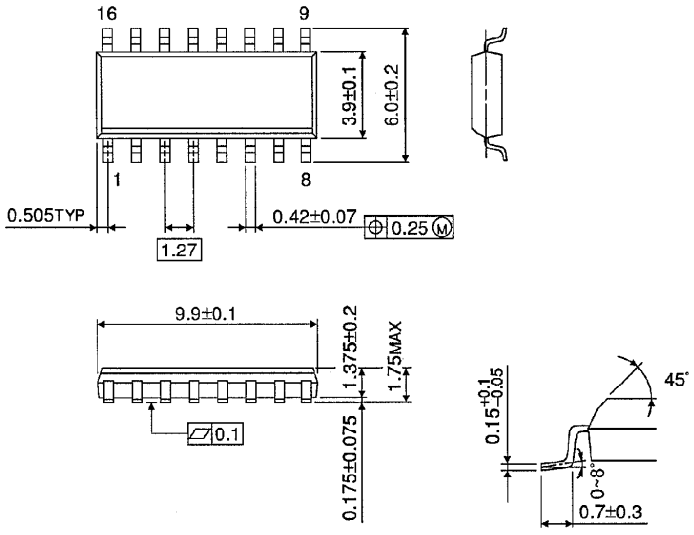
**SOP 16PIN (200mil BODY) OUTLINE DRAWING (SOP16-P-300-1.27)** Unit in mm




Weight : 0.18g (Typ.)

**SOP 16PIN (150mil BODY) OUTLINE DRAWING (SOL16-P-150 -1.27)** Unit in mm

(Note) This package is not available in Japan.




Weight : 0.13g (Typ.)