

**TC74AC166P, TC74AC166F, TC74AC166FN****8 - BIT SHIFT REGISTER (P - IN, S - OUT)**

The TC74AC166 is an advanced high speed CMOS 8-BIT PARALLEL/SERIAL-IN, SERIAL-OUT SHIFT REGISTER fabricated with silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

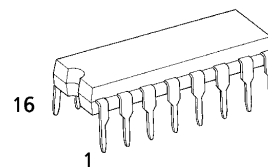
It consists of parallel-in or serial-in, serial-out 8 - bit shift register with a gated clock input and an overriding clear input. The parallel-in or serial-in modes are controlled by the SHIFT/LOAD input. When the SHIFT/LOAD input is held high, the serial data input is enabled and the eight flip-flops perform serial shifting on each clock pulse. When held low, the parallel data inputs are enabled and synchronous loading occurs on the next clock pulse. Clocking is accomplished on the low-to-high transition of the clock pulse. The CLOCK-INHIBIT input should be shifted high only while the CLOCK input is held high. A direct clear input overrides all other inputs, including the clock, and sets all the flip-flops to zero. Functional details are shown in the truth table and the timing charts.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

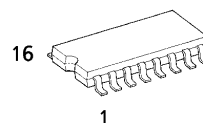
**FEATURES:**

- High Speed..... $f_{\text{MAX}} = 170\text{MHz}(\text{typ.})$  at  $V_{\text{CC}} = 5\text{V}$
- Low Power Dissipation..... $I_{\text{CC}} = 8\mu\text{A}(\text{Max.})$  at  $T_a = 25^\circ\text{C}$
- High Noise Immunity..... $V_{\text{NIH}} = V_{\text{NIL}} = 28\% V_{\text{CC}}(\text{Min.})$
- Symmetrical Output Impedance..... $|I_{\text{OH}}| = |I_{\text{OL}}| = 24\text{mA}(\text{Min.})$   
Capability of driving 50 $\Omega$  transmission lines.
- Balanced Propagation Delays..... $t_{\text{PLH}} \approx t_{\text{PHL}}$
- Wide Operating Voltage Range..... $V_{\text{CC}}(\text{opr}) = 2\text{V} \sim 5.5\text{V}$
- Pin and Function Compatible with 74HC166

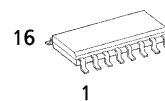
(Note) The JEDEC SOP (FN) is not available in Japan.



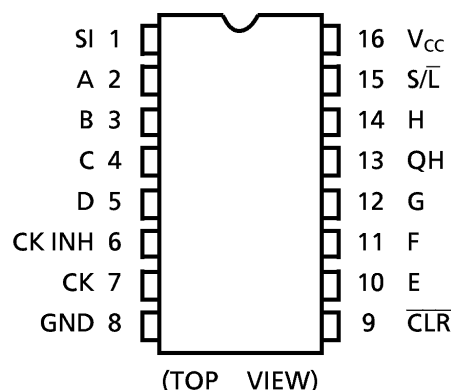
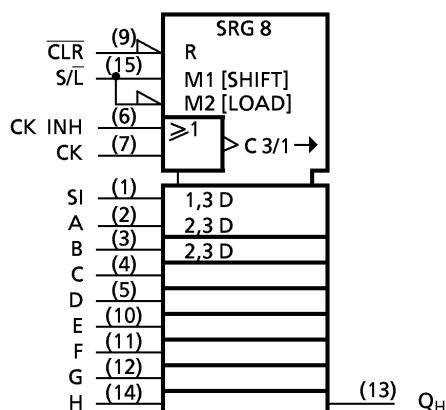
P (DIP16-P-300-2.54A)  
Weight : 1.00g (Typ.)



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



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

**PIN ASSIGNMENT****IEC LOGIC SYMBOL**

961001EBA2

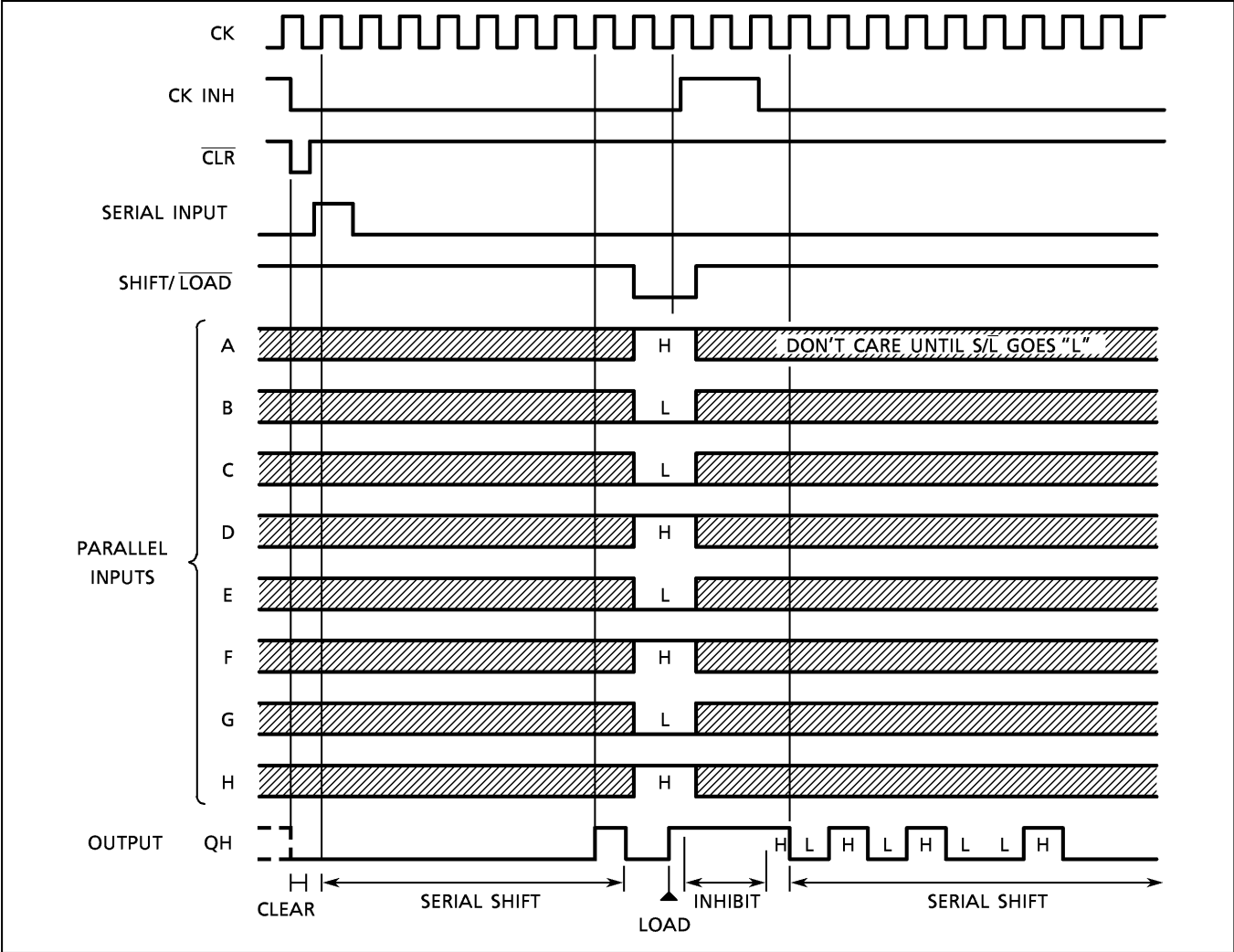
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TRUTH TABLE

| INPUTS |                |         |    |              |                       | INTERNAL<br>OUTPUTS |     | OUTPUT |
|--------|----------------|---------|----|--------------|-----------------------|---------------------|-----|--------|
| CLR    | SHIFT/<br>LOAD | CK INH. | CK | SERIAL<br>IN | PARALLEL<br>A ..... H | QA                  | QB  | QH     |
| L      | X              | X       | X  | X            | X                     | L                   | L   | L      |
| H      | X              | X       |    | X            | X                     | NO CHANGE           |     |        |
| H      | L              | L       |    | X            | a ..... h             | a                   | b   | h      |
| H      | H              | L       |    | H            | X                     | H                   | QAn | QGn    |
| H      | H              | L       |    | L            | X                     | L                   | QAn | QGn    |
| H      | X              | H       | X  | X            | X                     | NO CHANGE           |     |        |

X : Don't Care  
a ..... h : The level of steady state input voltage at inputs A through H respectively

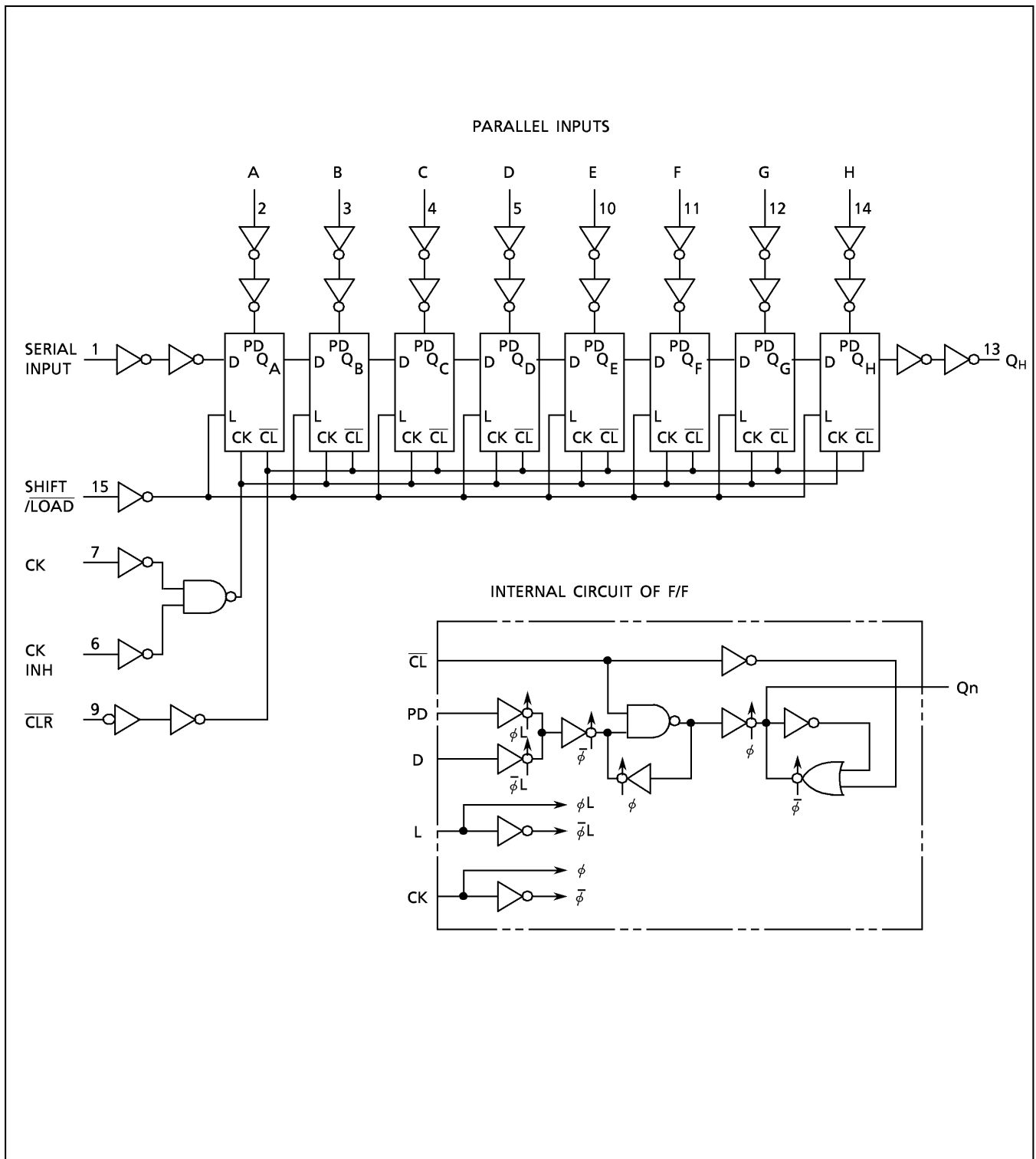
TIMING CHART



961001EBA2'

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## SYSTEM DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                   | SYMBOL    | VALUE                    | UNIT               |
|-----------------------------|-----------|--------------------------|--------------------|
| Supply Voltage Range        | $V_{CC}$  | $-0.5 \sim 7.0$          | V                  |
| DC Input Voltage            | $V_{IN}$  | $-0.5 \sim V_{CC} + 0.5$ | V                  |
| DC Output Voltage           | $V_{OUT}$ | $-0.5 \sim V_{CC} + 0.5$ | V                  |
| Input Diode Current         | $I_{IK}$  | $\pm 20$                 | mA                 |
| Output Diode Current        | $I_{OK}$  | $\pm 50$                 | mA                 |
| DC Output Current           | $I_{OUT}$ | $\pm 50$                 | mA                 |
| DC $V_{CC}$ /Ground Current | $I_{CC}$  | $\pm 100$                | mA                 |
| Power Dissipation           | $P_D$     | 500 (DIP)* / 180 (SOP)   | mW                 |
| Storage Temperature         | $T_{stg}$ | $-65 \sim 150$           | $^{\circ}\text{C}$ |

\*500mW in the range of  $T_a = -40^{\circ}\text{C} \sim 65^{\circ}\text{C}$ . From  $T_a = 65^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  a derating factor of  $-10\text{mW}/^{\circ}\text{C}$  should be applied up to 300mW.

## RECOMMENDED OPERATING CONDITIONS

| PARAMETER                | SYMBOL    | VALUE                                                                                           | UNIT               |
|--------------------------|-----------|-------------------------------------------------------------------------------------------------|--------------------|
| Supply Voltage           | $V_{CC}$  | $2.0 \sim 5.5$                                                                                  | V                  |
| Input Voltage            | $V_{IN}$  | $0 \sim V_{CC}$                                                                                 | V                  |
| Output Voltage           | $V_{OUT}$ | $0 \sim V_{CC}$                                                                                 | V                  |
| Operating Temperature    | $T_{opr}$ | $-40 \sim 85$                                                                                   | $^{\circ}\text{C}$ |
| Input Rise and Fall Time | $dt/dV$   | $0 \sim 100$ ( $V_{CC} = 3.3 \pm 0.3\text{V}$ )<br>$0 \sim 20$ ( $V_{CC} = 5 \pm 0.5\text{V}$ ) | ns/V               |

## DC ELECTRICAL CHARACTERISTICS

| PARAMETER                   | SYMBOL   | TEST CONDITION                           | $V_{CC}$<br>(V)           | $T_a = 25^{\circ}\text{C}$ |                   |                      | $T_a = -40 \sim 85^{\circ}\text{C}$ |                      | UNIT          |
|-----------------------------|----------|------------------------------------------|---------------------------|----------------------------|-------------------|----------------------|-------------------------------------|----------------------|---------------|
|                             |          |                                          |                           | MIN.                       | TYP.              | MAX.                 | MIN.                                | MAX.                 |               |
| High - Level Input Voltage  | $V_{IH}$ |                                          | 2.0<br>3.0<br>5.5         | 1.50<br>2.10<br>3.85       | —<br>—<br>—       | —<br>—<br>—          | 1.50<br>2.10<br>3.85                | —<br>—<br>—          | V             |
| Low - Level Input Voltage   | $V_{IL}$ |                                          | 2.0<br>3.0<br>5.5         | —<br>—<br>—                | —<br>—<br>—       | 0.50<br>0.90<br>1.65 | —<br>—<br>—                         | 0.50<br>0.90<br>1.65 | V             |
| High - Level Output Voltage | $V_{OH}$ | $V_{IN} = V_{IH} \text{ or } V_{IL}$     | $I_{OH} = -50\mu\text{A}$ | 2.0<br>3.0<br>4.5          | 1.9<br>2.9<br>4.4 | 2.0<br>3.0<br>4.5    | —<br>—<br>—                         | 1.9<br>2.9<br>4.4    | V             |
|                             |          |                                          | $I_{OH} = -4\text{mA}$    | 3.0                        | 2.58              | —                    | —                                   | 2.48                 |               |
|                             |          |                                          | $I_{OH} = -24\text{mA}$   | 4.5                        | 3.94              | —                    | —                                   | 3.80                 |               |
|                             |          |                                          | $I_{OH} = -75\text{mA}^*$ | 5.5                        | —                 | —                    | —                                   | 3.85                 |               |
| Low - Level Output Voltage  | $V_{OL}$ | $V_{IN} = V_{IH} \text{ or } V_{IL}$     | $I_{OL} = 50\mu\text{A}$  | 2.0<br>3.0<br>4.5          | —<br>—<br>—       | 0.0<br>0.0<br>0.0    | 0.1<br>0.1<br>0.1                   | —<br>—<br>—          | V             |
|                             |          |                                          | $I_{OL} = 12\text{mA}$    | 3.0                        | —                 | —                    | 0.36                                | —                    |               |
|                             |          |                                          | $I_{OL} = 24\text{mA}$    | 4.5                        | —                 | —                    | 0.36                                | —                    |               |
|                             |          |                                          | $I_{OL} = 75\text{mA}^*$  | 5.5                        | —                 | —                    | —                                   | 1.65                 |               |
| Input Leakage Current       | $I_{IN}$ | $V_{IN} = V_{CC} \text{ or } \text{GND}$ | 5.5                       | —                          | —                 | $\pm 0.1$            | —                                   | $\pm 1.0$            | $\mu\text{A}$ |
| Quiescent Supply Current    | $I_{CC}$ | $V_{IN} = V_{CC} \text{ or } \text{GND}$ | 5.5                       | —                          | —                 | 8.0                  | —                                   | 80.0                 |               |

\* : This spec indicates the capability of driving  $50\Omega$  transmission lines.

One output should be tested at a time for a 10ms maximum duration.

TIMING REQUIREMENTS ( Input  $t_r = t_f = 3\text{ns}$  )

| PARAMETER                                           | SYMBOL                   | TEST CONDITION | Ta = 25°C                      |            | Ta = -40~85°C |            | UNIT |
|-----------------------------------------------------|--------------------------|----------------|--------------------------------|------------|---------------|------------|------|
|                                                     |                          |                | V <sub>CC</sub> (V)            | LIMIT      | LIMIT         | LIMIT      |      |
| Minimum Pulse Width<br>(CK)                         | $t_{W(H)}$<br>$t_{W(L)}$ |                | $3.3 \pm 0.3$                  | 7.0        | 7.0           | 7.0        | ns   |
|                                                     |                          |                | $5.0 \pm 0.5$                  | 5.0        | 5.0           | 5.0        |      |
| Minimum Pulse Width<br>( $\overline{\text{CLR}}$ )  | $t_{W(L)}$               |                | $3.3 \pm 0.3$<br>$5.0 \pm 0.5$ | 8.0<br>5.0 | 8.0<br>5.0    | 8.0<br>5.0 |      |
| Minimum Set-up Time<br>(SI, PI)                     | $t_s$                    |                | $3.3 \pm 0.3$<br>$5.0 \pm 0.5$ | 8.0<br>4.0 | 8.0<br>4.0    | 8.0<br>4.0 |      |
| Minimum Set-up Time<br>(S/ $\overline{\text{L}}$ )  | $t_s$                    |                | $3.3 \pm 0.3$<br>$5.0 \pm 0.5$ | 7.0<br>4.0 | 7.0<br>4.0    | 7.0<br>4.0 |      |
| Minimum Hold Time<br>(SI, PI)                       | $t_h$                    |                | $3.3 \pm 0.3$<br>$5.0 \pm 0.5$ | 0.5<br>0.5 | 0.5<br>0.5    | 0.5<br>0.5 |      |
| Minimum Hold Time<br>(S/ $\overline{\text{L}}$ )    | $t_h$                    |                | $3.3 \pm 0.3$<br>$5.0 \pm 0.5$ | 1.0<br>1.0 | 1.0<br>1.0    | 1.0<br>1.0 |      |
| Minimum Removal Time<br>( $\overline{\text{CLR}}$ ) | $t_{\text{rem}}$         |                | $3.3 \pm 0.3$<br>$5.0 \pm 0.5$ | 4.0<br>1.5 | 4.0<br>1.5    | 4.0<br>1.5 |      |

AC ELECTRICAL CHARACTERISTICS ( C<sub>L</sub> = 50pF, R<sub>L</sub> = 500  $\Omega$ , Input  $t_r = t_f = 3\text{ns}$  )

| PARAMETER                                                | SYMBOL                               | TEST CONDITION |                        | Ta = 25°C |            |              | Ta = − 40~85°C |              | UNIT |
|----------------------------------------------------------|--------------------------------------|----------------|------------------------|-----------|------------|--------------|----------------|--------------|------|
|                                                          |                                      |                | V <sub>CC</sub> (V)    | MIN.      | TYP.       | MAX.         | MIN.           | MAX.         |      |
| Propagation Delay Time<br>(CK—QH)                        | t <sub>pLH</sub><br>t <sub>pHL</sub> |                | 3.3 ± 0.3<br>5.0 ± 0.5 | —<br>—    | 9.4<br>6.6 | 16.1<br>10.0 | 1.0<br>1.0     | 18.3<br>11.4 | ns   |
| Propagation Delay Time<br>( $\overline{\text{CLR}}$ —QH) | t <sub>pHL</sub>                     |                | 3.3 ± 0.3<br>5.0 ± 0.5 | —<br>—    | 9.2<br>6.4 | 15.2<br>9.6  | 1.0<br>1.0     | 17.4<br>10.9 |      |
| Maximum<br>Clock Frequency                               | f <sub>MAX</sub>                     |                | 3.3 ± 0.3<br>5.0 ± 0.5 | 55<br>90  | 105<br>150 | —<br>—       | 55<br>90       | —<br>—       | MHz  |
| Input Capacitance                                        | C <sub>IN</sub>                      |                |                        | —         | 5          | 10           | —              | 10           | pF   |
| Power Dissipation Capacitance                            | C <sub>PD</sub> (1)                  |                |                        | —         | 67         | —            | —              | —            |      |

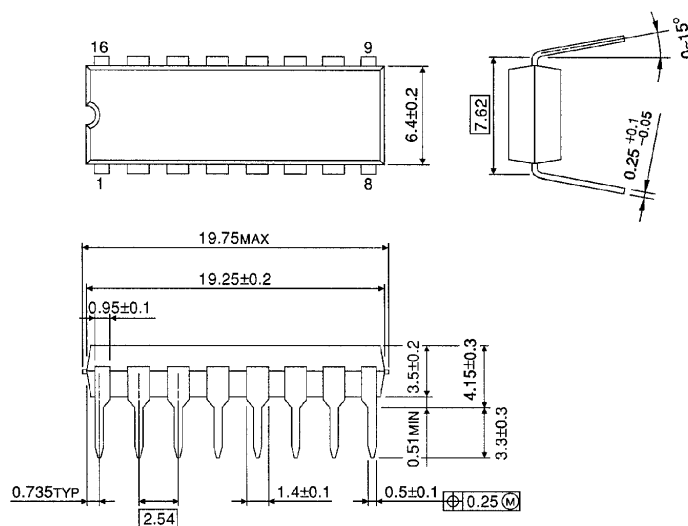
Note (1) C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

$$I_{CC}(\text{opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

## DIP 16PIN OUTLINE DRAWING (DIP16-P-300-2.54A)

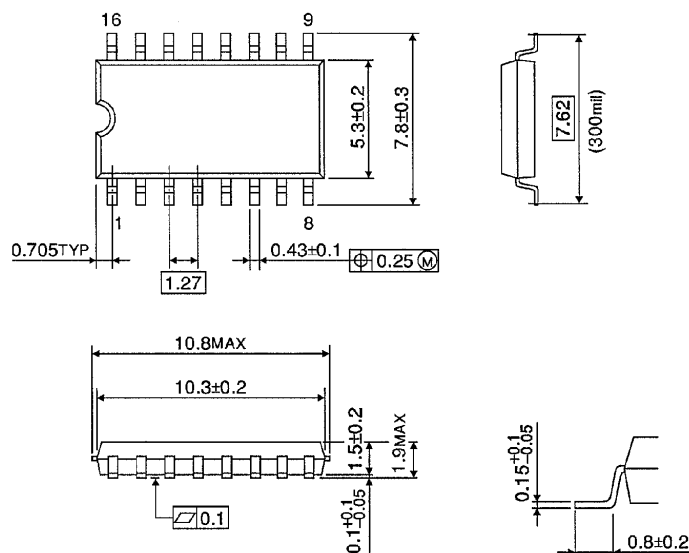
Unit in mm



Weight : 1.00g (Typ.)

## SOP 16PIN (200mil BODY) OUTLINE DRAWING (SOP16-P-300-1.27)

Unit in mm

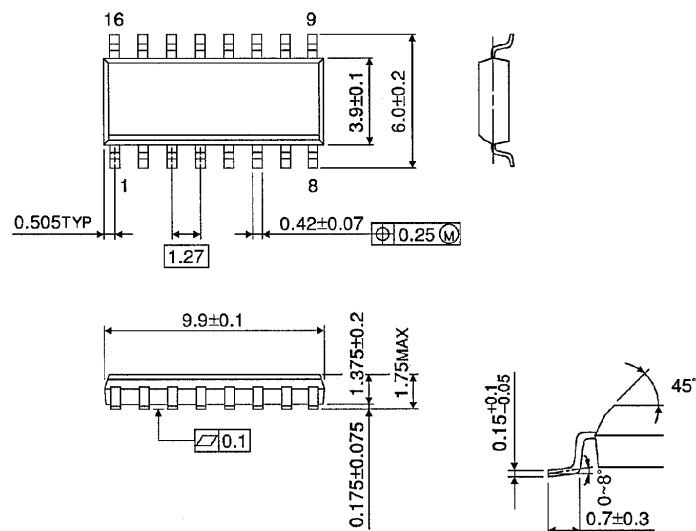


Weight : 0.18g (Typ.)

**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.)