

## TC74HC112AP, TC74HC112AF, TC74HC112AFN

### Dual J-K Flip Flop with Preset and Clear

The TC74HC112A is a high speed CMOS DUAL J-K FLIP FLOP fabricated with silicon gate C<sup>2</sup>MOS technology.

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

In accordance with the logic levels applied to the J and K inputs, the outputs change state on the negative going transition of the clock pulse.

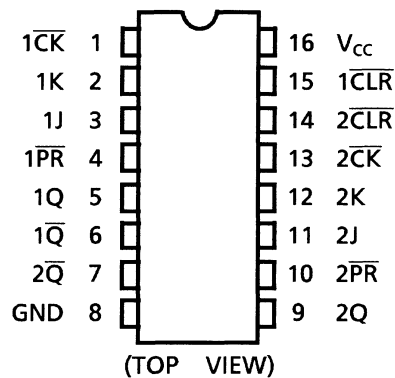
$\overline{\text{CLR}}$  and  $\overline{\text{PR}}$  are independent of the clock and are activated by a low logic level on the corresponding input.

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

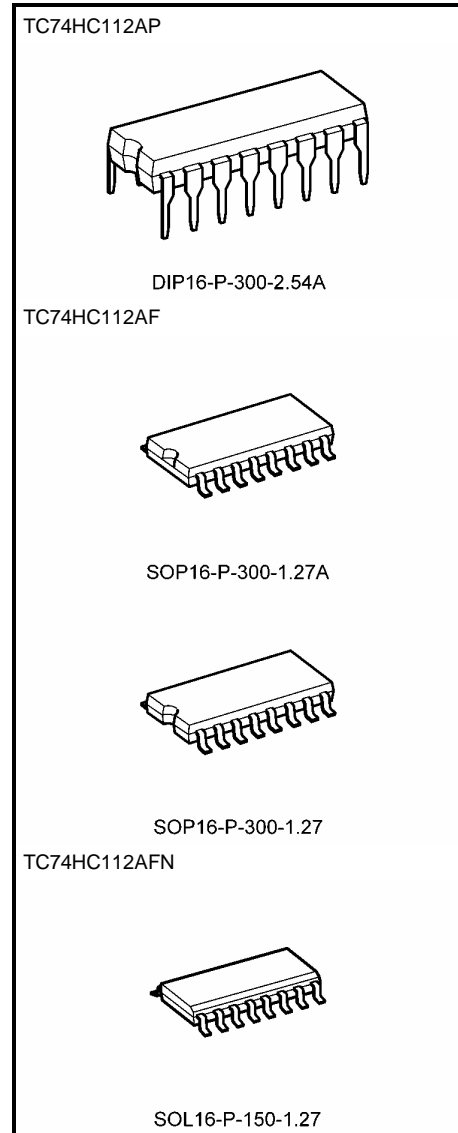
### Features

- High speed:  $f_{\text{max}} = 67 \text{ MHz (typ.)}$  at  $V_{\text{CC}} = 5 \text{ V}$
- Low power dissipation:  $I_{\text{CC}} = 2 \mu\text{A (max)}$  at  $T_{\text{a}} = 25^{\circ}\text{C}$
- High noise immunity:  $V_{\text{NIH}} = V_{\text{NIL}} = 28\% V_{\text{CC (min)}}$
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance:  $|I_{\text{OH}}| = I_{\text{OL}} = 4 \text{ mA (min)}$
- Balanced propagation delays:  $t_{\text{pLH}} \approx t_{\text{pHL}}$
- Wide operating voltage range:  $V_{\text{CC (opr)}} = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS112

### Pin Assignment

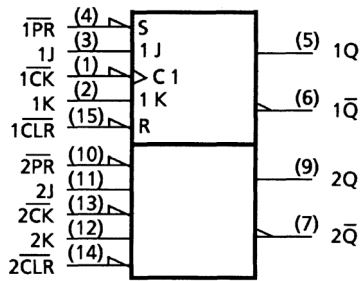


Note: xxxFN (JEDEC SOP) is not available in Japan.



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

## IEC Logic Symbol

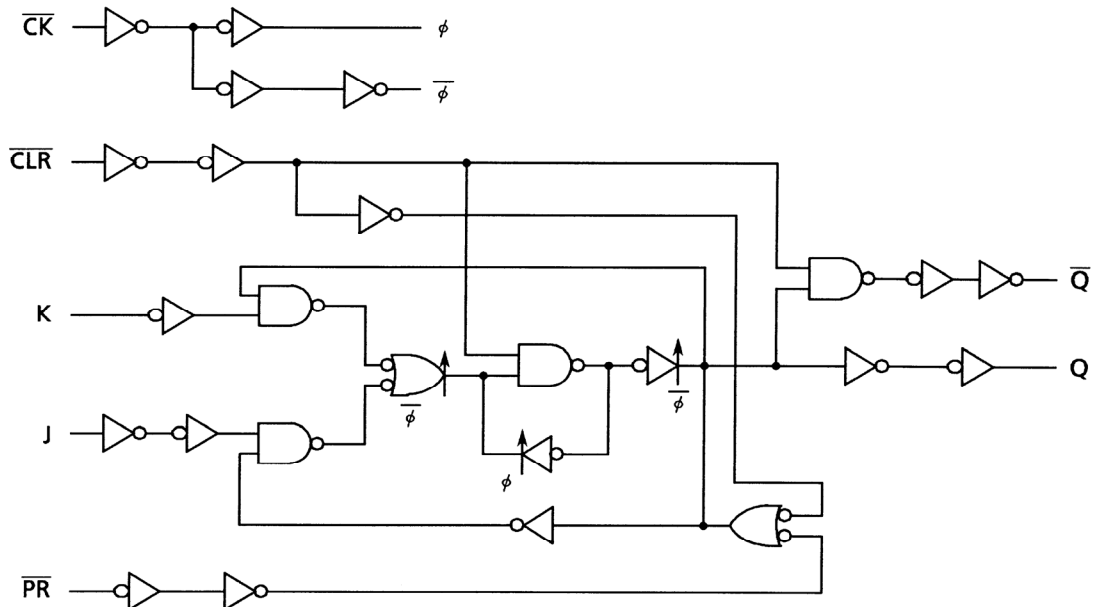


## Truth Table

| Inputs           |                 |   |   |                 | Outputs          |                  | Function  |
|------------------|-----------------|---|---|-----------------|------------------|------------------|-----------|
| $\overline{CLR}$ | $\overline{PR}$ | J | K | $\overline{CK}$ | Q                | $\overline{Q}$   |           |
| L                | H               | X | X | X               | L                | H                | Clear     |
| H                | L               | X | X | X               | H                | L                | Preset    |
| L                | L               | X | X | X               | H                | H                |           |
| H                | H               | L | L | $\downarrow$    | $Q_n$            | $\overline{Q}_n$ | No Change |
| H                | H               | L | H | $\downarrow$    | L                | H                |           |
| H                | H               | H | L | $\downarrow$    | H                | L                |           |
| H                | H               | H | H | $\downarrow$    | $\overline{Q}_n$ | $Q_n$            | Toggle    |
| H                | H               | X | X | $\uparrow$      | $Q_n$            | $\overline{Q}_n$ | No Change |

X: Don't care

## System Diagram



## Absolute Maximum Ratings (Note 1)

| Characteristics             | Symbol    | Rating                       | Unit |
|-----------------------------|-----------|------------------------------|------|
| Supply voltage range        | $V_{CC}$  | -0.5 to 7                    | V    |
| DC input voltage            | $V_{IN}$  | -0.5 to $V_{CC} + 0.5$       | V    |
| DC output voltage           | $V_{OUT}$ | -0.5 to $V_{CC} + 0.5$       | V    |
| Input diode current         | $I_{IK}$  | $\pm 20$                     | mA   |
| Output diode current        | $I_{OK}$  | $\pm 20$                     | mA   |
| DC output current           | $I_{OUT}$ | $\pm 25$                     | mA   |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 50$                     | mA   |
| Power dissipation           | $P_D$     | 500 (DIP) (Note 2)/180 (SOP) | mW   |
| Storage temperature         | $T_{stg}$ | -65 to 150                   | °C   |

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Note 2: 500 mW in the range of  $T_a = -40$  to  $65^\circ\text{C}$ . From  $T_a = 65$  to  $85^\circ\text{C}$  a derating factor of  $-10$  mW/°C shall be applied until 300 mW.

## Recommended Operating Conditions (Note)

| Characteristics          | Symbol     | Rating  | Unit |
|--------------------------|------------|---|------|
| Supply voltage           | $V_{CC}$   | 2 to 6  | V    |
| Input voltage            | $V_{IN}$   | 0 to $V_{CC}$   | V    |
| Output voltage           | $V_{OUT}$  | 0 to $V_{CC}$   | V    |
| Operating temperature    | $T_{opr}$  | -40 to 85   | °C   |
| Input rise and fall time | $t_r, t_f$ | 0 to 1000 ( $V_{CC} = 2.0$ V)<br>0 to 500 ( $V_{CC} = 4.5$ V)<br>0 to 400 ( $V_{CC} = 6.0$ V) | ns   |

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.

**Electrical Characteristics**

**DC Characteristics**

| Characteristics           | Symbol          | Test Condition  |  | Ta = 25°C           |      |      | Ta = -40 to 85°C |      | Unit |     |
|---------------------------|-----------------|---|--|---------------------|------|------|------------------|------|------|-----|
|                           |                 |   |  | V <sub>CC</sub> (V) | Min  | Typ. | Max              | Min  |      | Max |
| High-level input voltage  | V <sub>IH</sub> | —   |  | 2.0                 | 1.50 | —    | —                | 1.50 | —    | V   |
|                           |                 |   |  | 4.5                 | 3.15 | —    | —                | 3.15 | —    |     |
|                           |                 |   |  | 6.0                 | 4.20 | —    | —                | 4.20 | —    |     |
| Low-level input voltage   | V <sub>IL</sub> | —   |  | 2.0                 | —    | —    | 0.50             | —    | 0.50 | V   |
|                           |                 |   |  | 4.5                 | —    | —    | 1.35             | —    | 1.35 |     |
|                           |                 |   |  | 6.0                 | —    | —    | 1.80             | —    | 1.80 |     |
| High-level output voltage | V <sub>OH</sub> | V <sub>IN</sub><br>= V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OH</sub> = -20 μA                             | 2.0                 | 1.9  | 2.0  | —                | 1.9  | —    | V   |
|                           |                 |   |  | 4.5                 | 4.4  | 4.5  | —                | 4.4  | —    |     |
|                           |                 |   | I <sub>OH</sub> = -4 mA<br>I <sub>OH</sub> = -5.2 mA | 4.5                 | 4.18 | 4.31 | —                | 4.13 | —    |     |
|                           |                 |   |  | 6.0                 | 5.68 | 5.80 | —                | 5.63 | —    |     |
| Low-level output voltage  | V <sub>OL</sub> | V <sub>IN</sub><br>= V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OL</sub> = 20 μA                              | 2.0                 | —    | 0.0  | 0.1              | —    | 0.1  | V   |
|                           |                 |   |  | 4.5                 | —    | 0.0  | 0.1              | —    | 0.1  |     |
|                           |                 |   | I <sub>OL</sub> = 4 mA<br>I <sub>OL</sub> = 5.2 mA   | 4.5                 | —    | 0.17 | 0.26             | —    | 0.33 |     |
|                           |                 |   |  | 6.0                 | —    | 0.18 | 0.26             | —    | 0.33 |     |
| Input leakage current     | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                |  | 6.0                 | —    | —    | ±0.1             | —    | ±1.0 | μA  |
| Quiescent supply current  | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                |  | 6.0                 | —    | —    | 2.0              | —    | 20.0 | μA  |

### Timing Requirements (input: $t_r = t_f = 6 \text{ ns}$ )

| Characteristics  | Symbol                 | Test Condition | Ta = 25°C           |      | Ta = -40 to 85°C |       | Unit |
|--|------------------------|----------------|---------------------|------|------------------|-------|------|
|  |                        |                | V <sub>CC</sub> (V) | Typ. | Limit            | Limit |      |
| Minimum pulse width<br>( $\overline{\text{CK}}$ )                            | $t_W$ (L)<br>$t_W$ (H) | —              | 2.0                 | —    | 75               | 95    | ns   |
|  |                        |                | 4.5                 | —    | 15               | 19    |      |
|  |                        |                | 6.0                 | —    | 13               | 16    |      |
| Minimum pulse width<br>( $\overline{\text{CLR}}$ , $\overline{\text{PR}}$ )  | $t_W$ (L)              | —              | 2.0                 | —    | 75               | 95    | ns   |
|  |                        |                | 4.5                 | —    | 15               | 19    |      |
|  |                        |                | 6.0                 | —    | 13               | 16    |      |
| Minimum set-up time  | $t_s$                  | —              | 2.0                 | —    | 75               | 95    | ns   |
|  |                        |                | 4.5                 | —    | 15               | 19    |      |
|  |                        |                | 6.0                 | —    | 13               | 16    |      |
| Minimum hold time  | $t_h$                  | —              | 2.0                 | —    | 0                | 0     | ns   |
|  |                        |                | 4.5                 | —    | 0                | 0     |      |
|  |                        |                | 6.0                 | —    | 0                | 0     |      |
| Minimum removal time<br>( $\overline{\text{CLR}}$ , $\overline{\text{PR}}$ ) | $t_{\text{rem}}$       | —              | 2.0                 | —    | 50               | 60    | ns   |
|  |                        |                | 4.5                 | —    | 10               | 12    |      |
|  |                        |                | 6.0                 | —    | 9                | 11    |      |
| Clock frequency  | f                      | —              | 2.0                 | —    | 6                | 4     | MHz  |
|  |                        |                | 4.5                 | —    | 30               | 24    |      |
|  |                        |                | 6.0                 | —    | 34               | 28    |      |

### AC Characteristics ( $C_L = 15 \text{ pF}$ , $V_{CC} = 5 \text{ V}$ , $T_a = 25^\circ\text{C}$ , input: $t_r = t_f = 6 \text{ ns}$ )

| Characteristics   | Symbol           | Test Condition | Min | Typ. | Max | Unit |
|---|------------------|----------------|-----|------|-----|------|
| Output transition time  | $t_{\text{TLH}}$ | —              | —   | 4    | 8   | ns   |
|   | $t_{\text{THL}}$ |                |     |      |     |      |
| Propagation delay time<br>( $\overline{\text{CK}} - Q$ , $\overline{Q}$ )                           | $t_{\text{pLH}}$ | —              | —   | 13   | 21  | ns   |
|   | $t_{\text{pHL}}$ |                |     |      |     |      |
| Propagation delay time<br>( $\overline{\text{CLR}}$ , $\overline{\text{PR}} - Q$ , $\overline{Q}$ ) | $t_{\text{pLH}}$ | —              | —   | 15   | 22  | ns   |
|   | $t_{\text{pHL}}$ |                |     |      |     |      |
| Maximum clock frequency   | $f_{\text{max}}$ | —              | 32  | 67   | —   | MHz  |

## AC Characteristics ( $C_L = 50 \text{ pF}$ , input: $t_r = t_f = 6 \text{ ns}$ )

| Characteristics  | Symbol                               | Test Condition | V <sub>CC</sub><br>(V) | Ta = 25°C |      |     | Ta = -40 to 85°C |     | Unit |
|--|--------------------------------------|----------------|------------------------|-----------|------|-----|------------------|-----|------|
|  |                                      |                |                        | Min       | Typ. | Max | Min              | Max |      |
| Output transition time   | t <sub>TLH</sub><br>t <sub>THL</sub> | —              | 2.0                    | —         | 30   | 75  | —                | 95  | ns   |
|  |                                      |                | 4.5                    | —         | 8    | 15  | —                | 19  |      |
|  |                                      |                | 6.0                    | —         | 7    | 13  | —                | 16  |      |
| Propagation delay time<br>( $\overline{\text{CK}}\text{-Q, } \overline{\text{Q}}$ )                        | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 2.0                    | —         | 52   | 125 | —                | 155 | ns   |
|  |                                      |                | 4.5                    | —         | 16   | 25  | —                | 31  |      |
|  |                                      |                | 6.0                    | —         | 14   | 21  | —                | 26  |      |
| Propagation delay time<br>( $\overline{\text{CLR}}, \overline{\text{PR}}\text{-Q, } \overline{\text{Q}}$ ) | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 2.0                    | —         | 68   | 135 | —                | 170 | ns   |
|  |                                      |                | 4.5                    | —         | 17   | 27  | —                | 34  |      |
|  |                                      |                | 6.0                    | —         | 15   | 23  | —                | 29  |      |
| Maximum clock frequency  | f <sub>max</sub>                     | —              | 2.0                    | 6         | 19   | —   | 4                | —   | MHz  |
|  |                                      |                | 4.5                    | 30        | 63   | —   | 24               | —   |      |
|  |                                      |                | 6.0                    | 34        | 71   | —   | 28               | —   |      |
| Input capacitance  | C <sub>IN</sub>                      | —              | —                      | 5         | 10   | —   | 10               | pF  |      |
| Power dissipation capacitance  | C <sub>PD</sub><br>(Note)            | —              | —                      | 35        | —    | —   | —                | pF  |      |

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

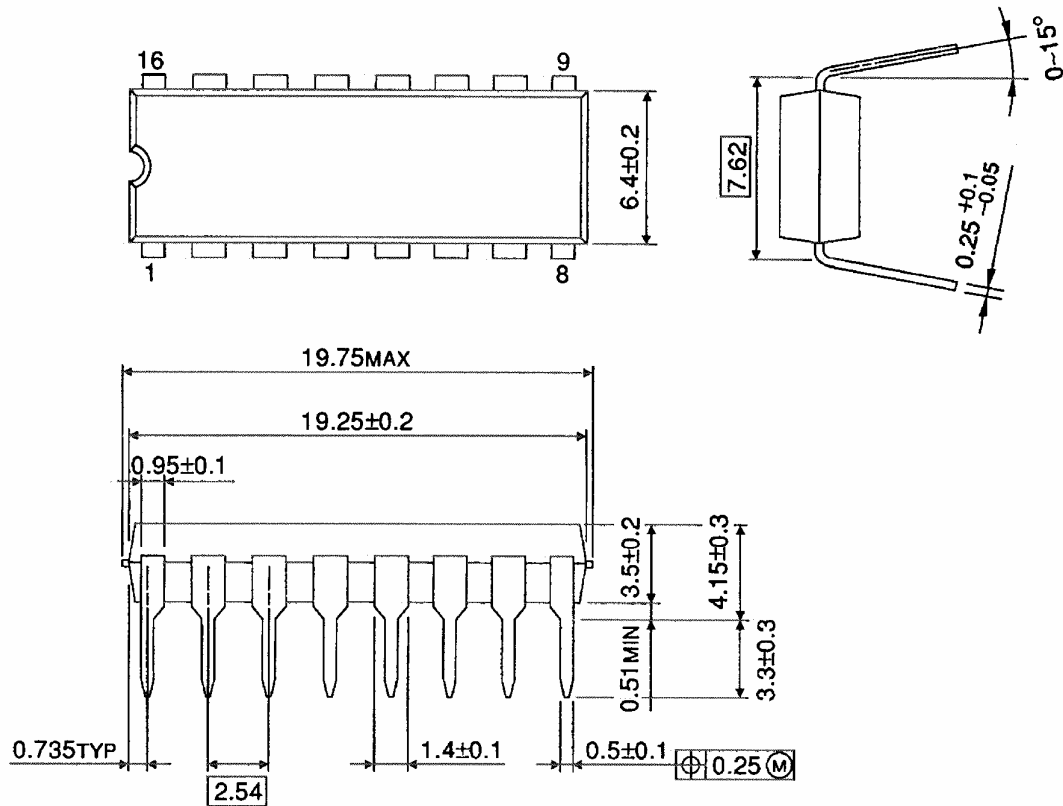
Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2 \text{ (per F/F)}$$

## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

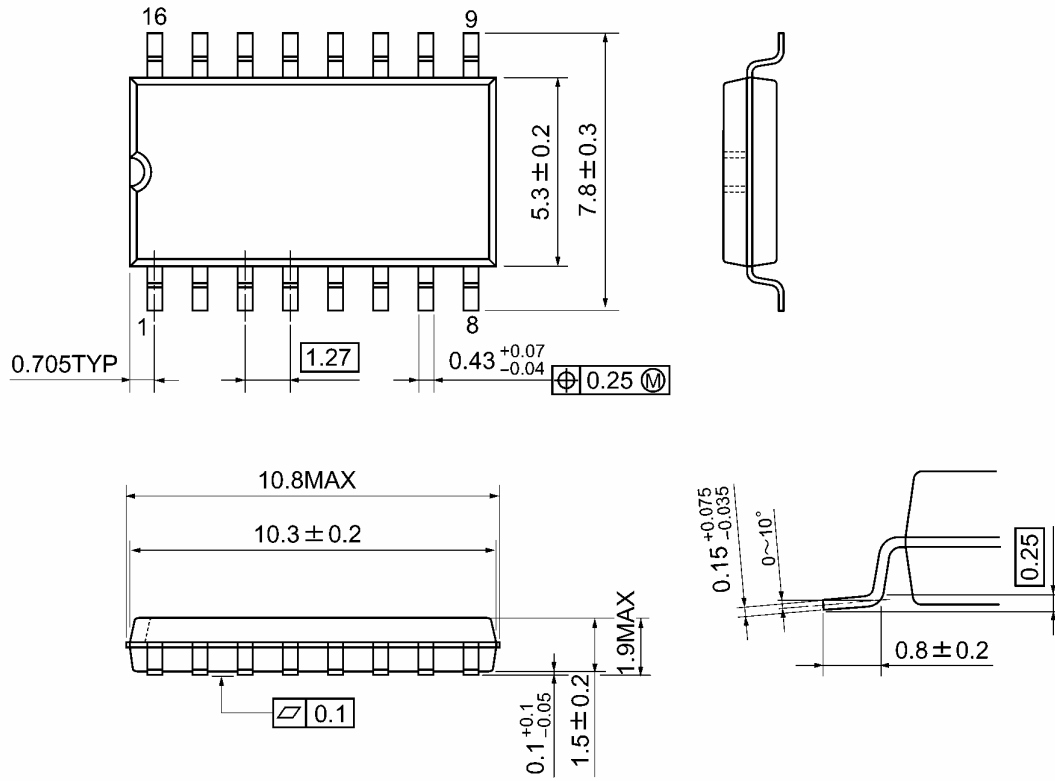


Weight: 1.00 g (typ.)

## Package Dimensions

SOP16-P-300-1.27A

Unit: mm



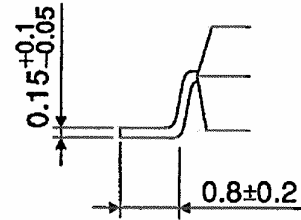
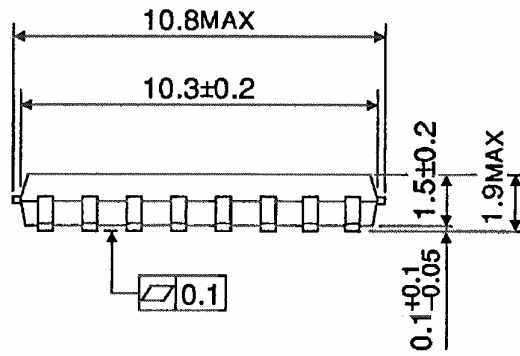
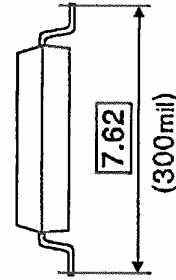
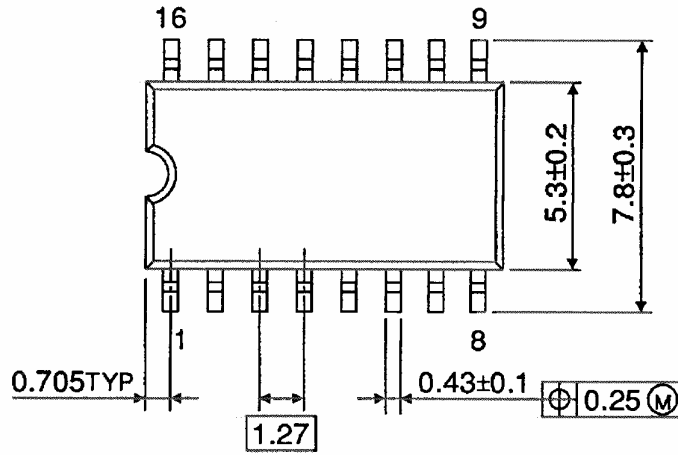
Weight: 0.18 g (typ.)



## Package Dimensions

SOP16-P-300-1.27

Unit : mm

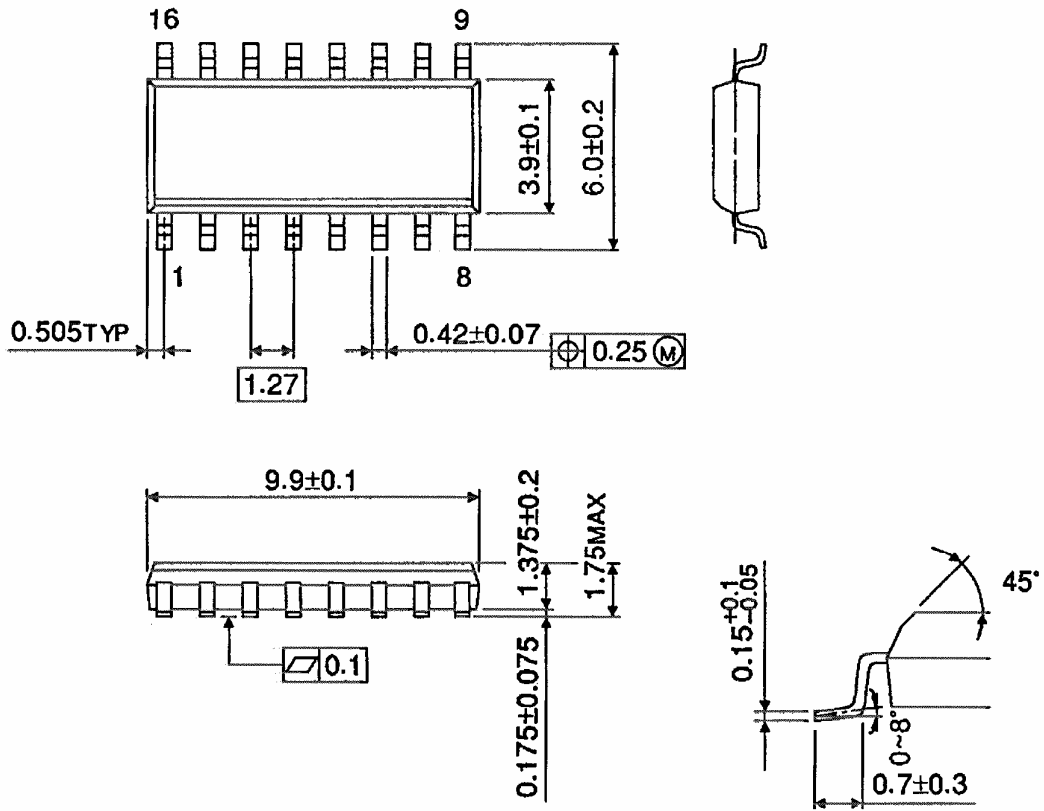


Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL16-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

Weight: 0.13 g (typ.)

**Note: Lead (Pb)-Free Packages****DIP16-P-300-2.54A SOP16-P-300-1.27A SOL16-P-150-1.27****RESTRICTIONS ON PRODUCT USE**

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