

## TC74HC174AP, TC74HC174AF, TC74HC174AFN

### Hex D-Type Flip Flop with Clear

The TC74HC174A is a high speed CMOS D-TYPE 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.

Information signals applied to the D inputs are transferred to the Q outputs on the positive going edge of the clock pulse.

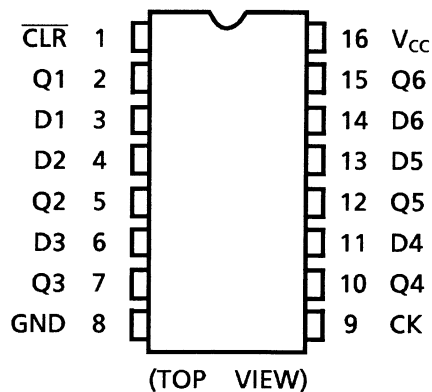
When the  $\overline{\text{CLR}}$  input is held low, the Q outputs are in the low logic level independent of the other inputs.

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

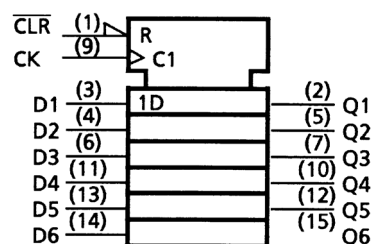
### Features

- High speed:  $f_{\text{max}} = 71 \text{ MHz}$  (typ.) at  $V_{\text{CC}} = 5 \text{ V}$
- Low power dissipation:  $I_{\text{CC}} = 4 \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{\text{NIH}} = V_{\text{NIL}} = 28\% V_{\text{CC}}$  (min)
- 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:  $V_{\text{CC}} (\text{opr}) = 2 \sim 6 \text{ V}$
- Pin and function compatible with 74LS174

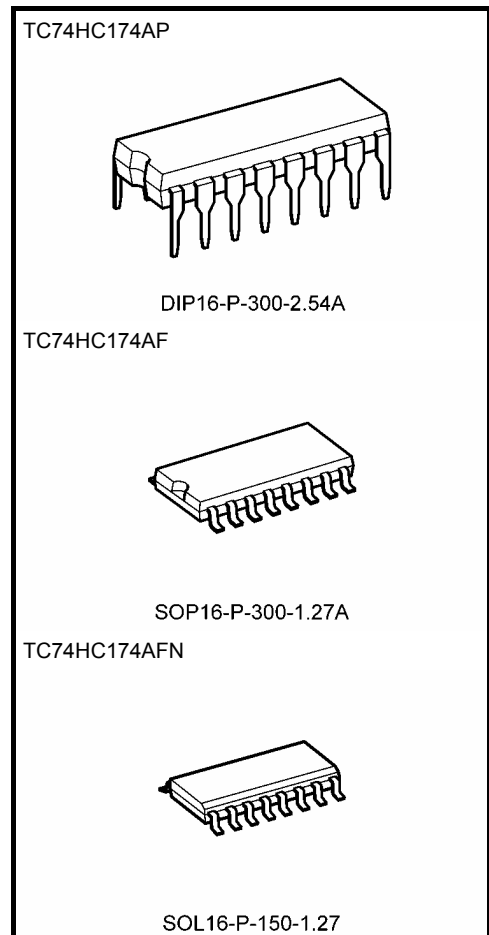
### Pin Assignment



### IEC Logic Symbol



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



### Weight

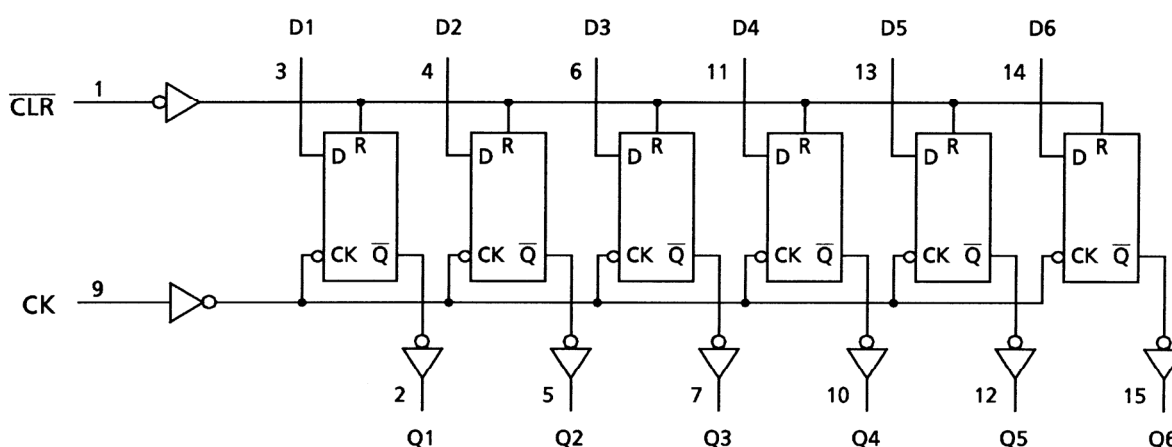
|                   |                 |
|-------------------|-----------------|
| DIP16-P-300-2.54A | : 1.00 g (typ.) |
| SOP16-P-300-1.27A | : 0.18 g (typ.) |
| SOL16-P-150-1.27  | : 0.13 g (typ.) |

## Truth Table

| Inputs                  |   |              | Output | Function  |
|-------------------------|---|--------------|--------|-----------|
| $\overline{\text{CLR}}$ | D | CK           | Q      |           |
| L                       | X | X            | L      | Clear     |
| H                       | L | $\uparrow$   | L      | —         |
| H                       | H | $\uparrow$   | H      | —         |
| H                       | X | $\downarrow$ | $Q_n$  | No Change |

X: Don't care

## System Diagram



## Absolute Maximum Ratings (Note 1)

| Characteristics             | Symbol    | Rating                       | Unit               |
|-----------------------------|-----------|------------------------------|--------------------|
| Supply voltage range        | $V_{CC}$  | -0.5~7                       | V                  |
| DC input voltage            | $V_{IN}$  | -0.5~ $V_{CC} + 0.5$         | V                  |
| DC output voltage           | $V_{OUT}$ | -0.5~ $V_{CC} + 0.5$         | 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         | $T_{stg}$ | -65~150                      | $^{\circ}\text{C}$ |

Note 1: 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).

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  $-10 \text{ mW}/^{\circ}\text{C}$  shall be applied until 300 mW.

## Operating Ranges (Note)

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

Note: The operating ranges must be maintained to ensure the normal operation of the device.  
Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

### DC Characteristics

| Characteristics           | Symbol | Test Condition   |              | Ta = 25°C         |                      |             | Ta = -40~85°C        |                      | Unit                 |     |
|---------------------------|--------|------------------|--------------|-------------------|----------------------|-------------|----------------------|----------------------|----------------------|-----|
|                           |        |                  |              | VCC (V)           | Min                  | Typ.        | Max                  | Min                  |                      | Max |
| High-level input voltage  | VIH    | —                |              | 2.0<br>4.5<br>6.0 | 1.50<br>3.15<br>4.20 | —<br>—<br>— | —<br>—<br>—          | 1.50<br>3.15<br>4.20 | V                    |     |
| Low-level input voltage   | VIL    | —                |              | 2.0<br>4.5<br>6.0 | —<br>—<br>—          | —<br>—<br>— | 0.50<br>1.35<br>1.80 | —<br>—<br>—          | 0.50<br>1.35<br>1.80 |     |
| High-level output voltage | VOH    | VIN = VIH or VIL | IOH = -20 μA | 2.0               | 1.9                  | 2.0         | —                    | 1.9                  | —                    |     |
|                           |        |                  |              | 4.5               | 4.4                  | 4.5         | —                    | 4.4                  | —                    |     |
|                           |        |                  |              | 6.0               | 5.9                  | 6.0         | —                    | 5.9                  | —                    |     |
|                           |        |                  | IOH = -4 mA  | 4.5               | 4.18                 | 4.31        | —                    | 4.13                 | —                    |     |
| IOH = -5.2 mA             | 6.0    | 5.68             | 5.80         | —                 | 5.63                 | —           |                      |                      |                      |     |
| Low-level output voltage  | VOL    | VIN = VIH or VIL | IOL = 20 μA  | 2.0               | —                    | 0.0         | 0.1                  | —                    | 0.1                  |     |
|                           |        |                  |              | 4.5               | —                    | 0.0         | 0.1                  | —                    | 0.1                  |     |
|                           |        |                  |              | 6.0               | —                    | 0.0         | 0.1                  | —                    | 0.1                  |     |
|                           |        |                  | IOL = 4 mA   | 4.5               | —                    | 0.17        | 0.26                 | —                    | 0.33                 |     |
|                           |        |                  | IOL = 5.2 mA | 6.0               | —                    | 0.18        | 0.26                 | —                    | 0.33                 |     |
| Input leakage current     | IIN    | VIN = VCC or GND |              | 6.0               | —                    | —           | ±0.1                 | —                    | ±1.0                 | μA  |
| Quiescent supply current  | ICC    | VIN = VCC or GND |              | 6.0               | —                    | —           | 4.0                  | —                    | 40.0                 | μA  |

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

| Characteristics                                     | Symbol                 | Test Condition | Ta = 25°C           |      | Ta = -40 ~ 85°C |       | Unit |
|-----------------------------------------------------|------------------------|----------------|---------------------|------|-----------------|-------|------|
|                                                     |                        |                | V <sub>CC</sub> (V) | Typ. | Limit           | Limit |      |
| Minimum pulse width<br>(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>( $\overline{\text{CLR}}$ )  | $t_W$ (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>( $\overline{\text{CLR}}$ ) | $t_{\text{rem}}$       | —              | 2.0                 | —    | 25              | 30    | ns   |
|                                                     |                        |                | 4.5                 | —    | 5               | 6     |      |
|                                                     |                        |                | 6.0                 | —    | 4               | 5     |      |
| Clock frequency                                     | f                      | —              | 2.0                 | —    | 6               | 4     | MHz  |
|                                                     |                        |                | 4.5                 | —    | 33              | 26    |      |
|                                                     |                        |                | 6.0                 | —    | 38              | 30    |      |

**AC Characteristics ( $C_L = 15 \text{ pF}$ ,  $V_{CC} = 5 \text{ V}$ , Ta = 25°C, input:  $t_r = t_f = 6 \text{ ns}$ )**

| Characteristics                                         | Symbol           | Test Condition | Min | Typ. | Max | Unit |
|---------------------------------------------------------|------------------|----------------|-----|------|-----|------|
| Output transition time                                  | $t_{TLH}$        | —              | —   | 4    | 8   | ns   |
|                                                         | $t_{THL}$        |                |     |      |     |      |
| Propagation delay time<br>(CK-Q)                        | $t_{pLH}$        | —              | —   | 14   | 26  | ns   |
|                                                         | $t_{pHL}$        |                |     |      |     |      |
| Propagation delay time<br>( $\overline{\text{CLR}}$ -Q) | $t_{pHL}$        | —              | —   | 15   | 26  | ns   |
| Maximum clock frequency                                 | $f_{\text{max}}$ | —              | 39  | 71   | —   | MHz  |

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

| Characteristics                                         | Symbol                 | Test Condition | Ta = 25°C           |     |      | Ta = -40~85°C |     | Unit |
|---------------------------------------------------------|------------------------|----------------|---------------------|-----|------|---------------|-----|------|
|                                                         |                        |                | V <sub>CC</sub> (V) | Min | Typ. | Max           | Min | Max  |
| Output transition time                                  | $t_{TLH}$<br>$t_{THL}$ | —              | 2.0                 | —   | 27   | 75            | —   | 95   |
|                                                         |                        |                | 4.5                 | —   | 8    | 15            | —   | 19   |
|                                                         |                        |                | 6.0                 | —   | 7    | 13            | —   | 16   |
| Propagation delay time<br>(CK-Q)                        | $t_{pLH}$<br>$t_{pHL}$ | —              | 2.0                 | —   | 68   | 150           | —   | 190  |
|                                                         |                        |                | 4.5                 | —   | 17   | 30            | —   | 38   |
|                                                         |                        |                | 6.0                 | —   | 14   | 26            | —   | 32   |
| Propagation delay time<br>( $\overline{\text{CLR}}$ -Q) | $t_{pHL}$              | —              | 2.0                 | —   | 72   | 150           | —   | 190  |
|                                                         |                        |                | 4.5                 | —   | 18   | 30            | —   | 38   |
|                                                         |                        |                | 6.0                 | —   | 15   | 26            | —   | 32   |
| Maximum clock frequency                                 | $f_{\text{max}}$       | —              | 2.0                 | 6   | 15   | —             | 4   | —    |
|                                                         |                        |                | 4.5                 | 33  | 59   | —             | 26  | —    |
|                                                         |                        |                | 6.0                 | 38  | 71   | —             | 30  | —    |
| Input capacitance                                       | $C_{IN}$               | —              | —                   | —   | 5    | 10            | —   | 10   |
| Power dissipation capacitance                           | $C_{PD}$<br>(Note)     | —              | —                   | —   | 40   | —             | —   | —    |

Note:  $C_{PD}$  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:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/6 \text{ (per flip flop)}$$

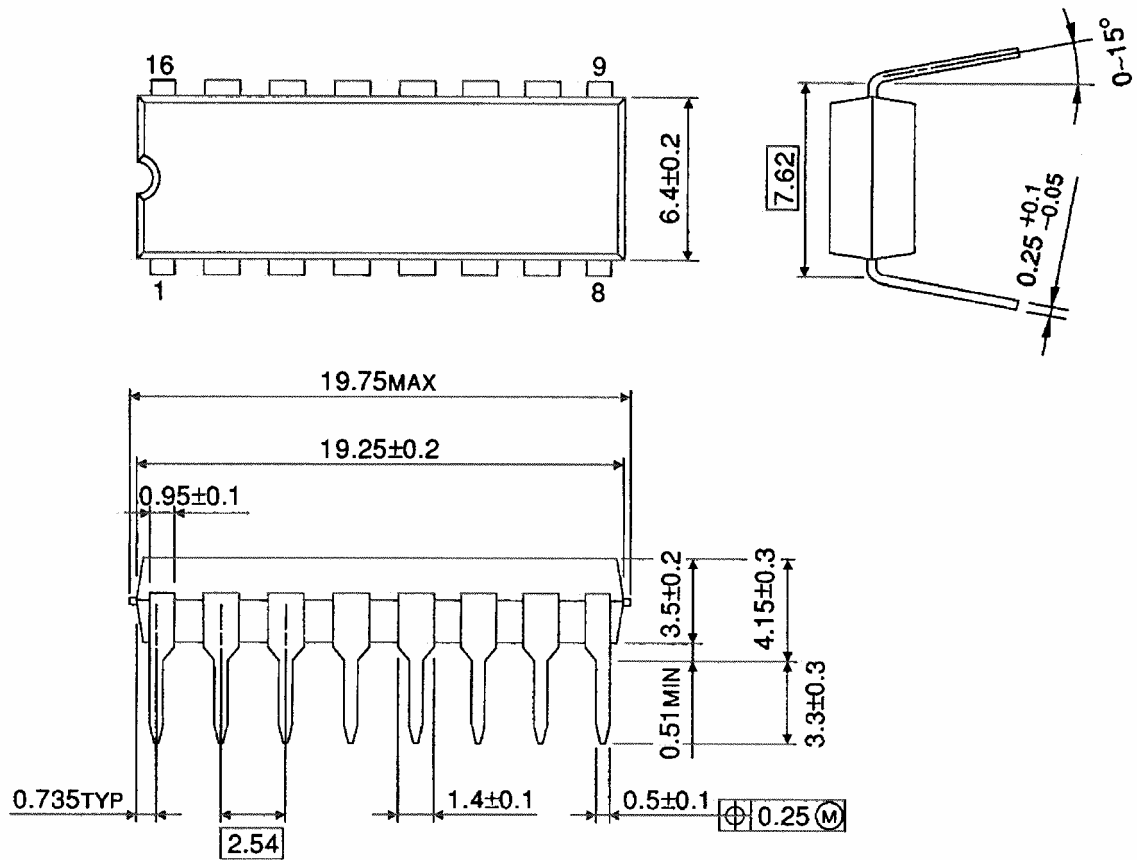
And the total  $C_{PD}$  when n pcs. of Flip Flop operate can be gained by the following equation:

$$C_{PD}(\text{total}) = 28 + 12 \cdot n$$

## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

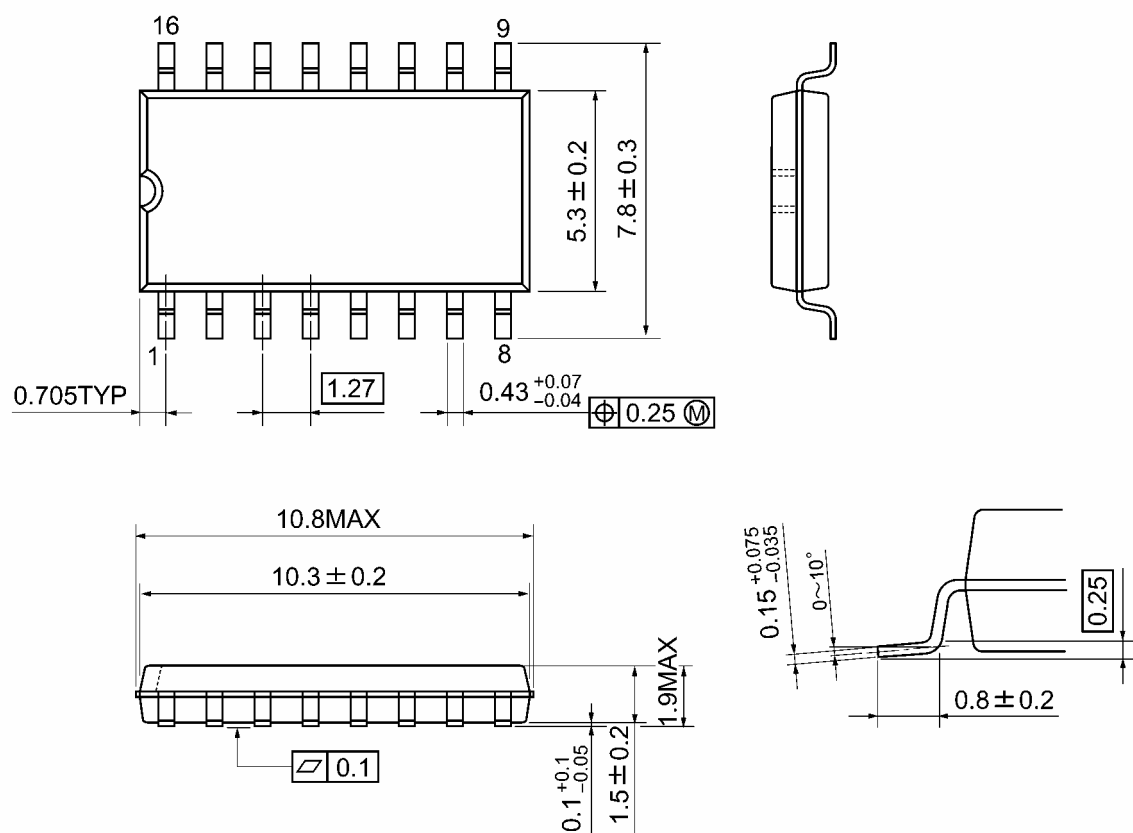


Weight: 1.00 g (typ.)

## Package Dimensions

SOP16-P-300-1.27A

Unit: mm

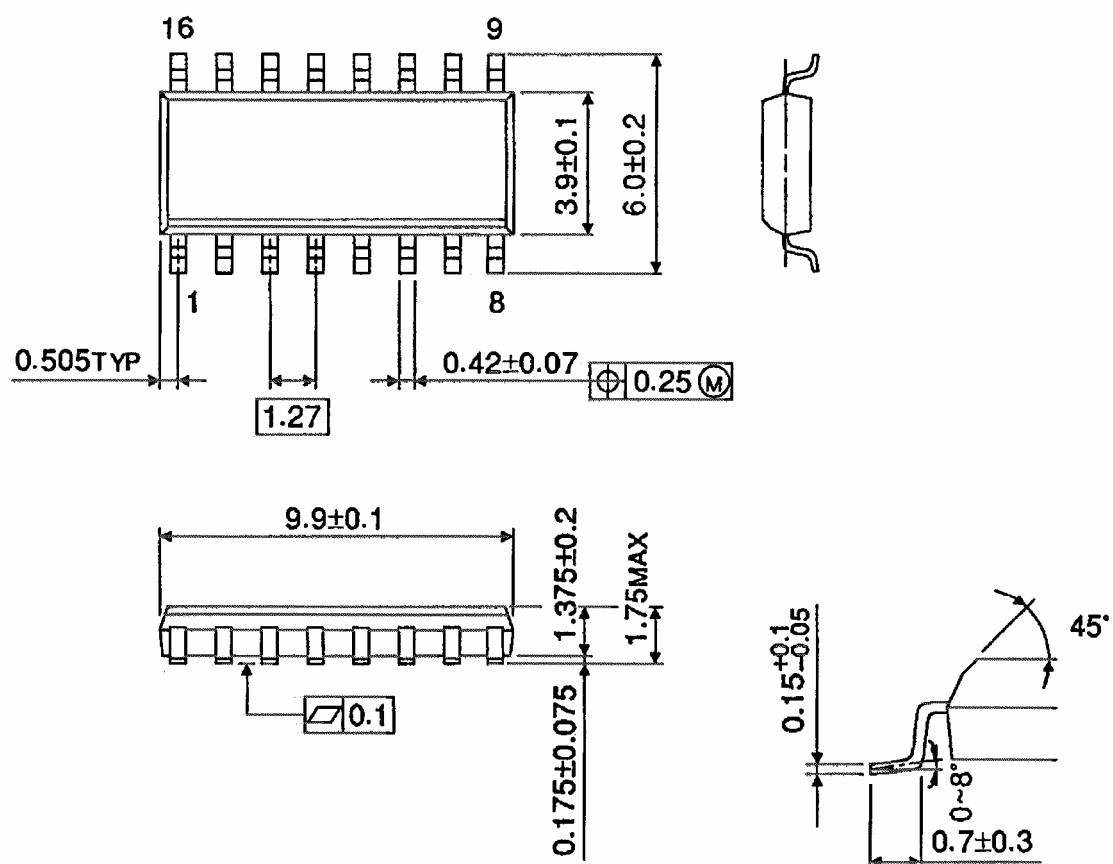


Weight: 0.18 g (typ.)

## Package Dimensions (Note)

SOL16-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

Weight: 0.13 g (typ.)

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20070701-EN GENERAL

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