

**TC74VHC74F,TC74VHC74FN,TC74VHC74FT,TC74VHC74FK****Dual D-Type Flip-Flop with Preset and Clear**

The TC74VHC74 is an advanced high speed CMOS D-FLIP FLOP fabricated with silicon gate 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.

The signal level applied to the D INPUT is transferred to Q OUTPUT during the positive going transition of the CK pulse.

$\overline{CLR}$  and  $\overline{PR}$  are independent of the CK and are accomplished by setting the appropriate input low.

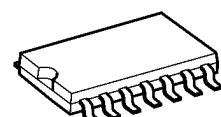
An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

**Features**

- High speed:  $f_{max} = 170$  MHz (typ.) at  $V_{CC} = 5$  V
- Low power dissipation:  $I_{CC} = 2$   $\mu$ A (max) at  $T_a = 25^\circ C$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\%$   $V_{CC}$  (min)
- Power down protection is provided on all inputs.
- Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- Wide operating voltage range:  $V_{CC}$  (opr) = 2 V to 5.5 V
- Pin and function compatible with 74ALS74

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

TC74VHC74F



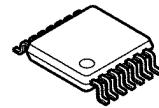
SOP14-P-300-1.27A

TC74VHC74FN



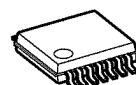
SOL14-P-150-1.27

TC74VHC74FT



TSSOP14-P-0044-0.65A

TC74VHC74FK

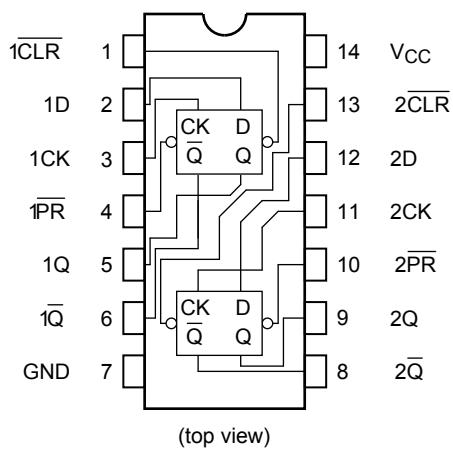


VSSOP14-P-0030-0.50

**Weight**

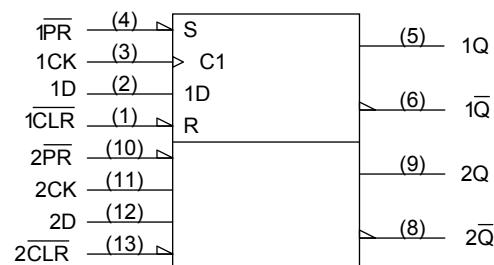
|                      |                 |
|----------------------|-----------------|
| SOP14-P-300-1.27A    | : 0.18 g (typ.) |
| SOL14-P-150-1.27     | : 0.12 g (typ.) |
| TSSOP14-P-0044-0.65A | : 0.06 g (typ.) |
| VSSOP14-P-0030-0.50  | : 0.02 g (typ.) |

## Pin Assignment



(top view)

## IEC Logic Symbol



## Truth Table

| Inputs |    |   |    | Outputs        |                     | Function  |
|--------|----|---|----|----------------|---------------------|-----------|
| CLR    | PR | D | CK | Q              | Q-bar               |           |
| L      | H  | X | X  | L              | H                   | Clear     |
| H      | L  | X | X  | H              | L                   | Preset    |
| L      | L  | X | X  | H              | H                   | —         |
| H      | H  | L | ↑  | L              | H                   | —         |
| H      | H  | H | ↑  | H              | L                   | —         |
| H      | H  | X | ↓  | Q <sub>n</sub> | Q <sub>n</sub> -bar | No Change |

X: Don't care

## Absolute Maximum Ratings (Note)

| Characteristics                    | Symbol           | Rating                        | Unit |
|------------------------------------|------------------|-------------------------------|------|
| Supply voltage range               | V <sub>CC</sub>  | -0.5 to 7.0                   | V    |
| DC input voltage                   | V <sub>IN</sub>  | -0.5 to 7.0                   | V    |
| DC output voltage                  | V <sub>OUT</sub> | -0.5 to V <sub>CC</sub> + 0.5 | V    |
| Input diode current                | I <sub>IK</sub>  | -20                           | mA   |
| Output diode current               | I <sub>OK</sub>  | ±20                           | mA   |
| DC output current                  | I <sub>OUT</sub> | ±25                           | mA   |
| DC V <sub>CC</sub> /ground current | I <sub>CC</sub>  | ±50                           | mA   |
| Power dissipation                  | P <sub>D</sub>   | 180                           | mW   |
| Storage temperature                | T <sub>stg</sub> | -65 to 150                    | °C   |

Note: 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.).

## Operating Ranges (Note)

| Characteristics          | Symbol    | Rating  | Unit |
|--------------------------|-----------|---|------|
| Supply voltage           | $V_{CC}$  | 2.0 to 5.5  | V    |
| Input voltage            | $V_{IN}$  | 0 to 5.5  | V    |
| Output voltage           | $V_{OUT}$ | 0 to $V_{CC}$   | V    |
| Operating temperature    | $T_{opr}$ | -40 to 85   | °C   |
| Input rise and fall time | $dt/dv$   | 0 to 100 ( $V_{CC} = 3.3 \pm 0.3$ V)<br>0 to 20 ( $V_{CC} = 5 \pm 0.5$ V) | ns/V |

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 to 85°C    |                     | Unit      |    |  |
|---------------------------|----------|-------------------------------|--------------------------------------|--------------|---------------------|------|---------------------|---------------------|-----------|----|--|
|                           |          |                               |                                      | $V_{CC}$ (V) | Min                 | Typ. | Max                 | Min                 |           |    |  |
| High-level input voltage  | $V_{IH}$ | —                             | $V_{IN} = V_{IH}$ or $V_{IL}$        | 2.0          | 1.50                | —    | —                   | 1.50                | V         |    |  |
|                           |          |                               |                                      | 3.0 to 5.5   | $V_{CC} \times 0.7$ | —    | —                   | $V_{CC} \times 0.7$ |           |    |  |
| Low-level input voltage   | $V_{IL}$ | —                             | $V_{IN} = V_{IH}$ or $V_{IL}$        | 2.0          | —                   | —    | 0.50                | —                   | V         |    |  |
|                           |          |                               |                                      | 3.0 to 5.5   | —                   | —    | $V_{CC} \times 0.3$ | —                   |           |    |  |
| High-level output voltage | $V_{OH}$ | $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OH} = -50 \mu A$                 | 2.0          | 1.9                 | 2.0  | —                   | 1.9                 | V         |    |  |
|                           |          |                               |                                      | 3.0          | 2.9                 | 3.0  | —                   | 2.9                 |           |    |  |
|                           |          |                               | $I_{OH} = -4 mA$<br>$I_{OH} = -8 mA$ | 4.5          | 4.4                 | 4.5  | —                   | 4.4                 |           |    |  |
|                           |          |                               |                                      | 3.0          | 2.58                | —    | —                   | 2.48                |           |    |  |
| Low-level output voltage  | $V_{OL}$ | $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OL} = 50 \mu A$                  | 4.5          | 3.94                | —    | —                   | 3.80                | V         |    |  |
|                           |          |                               |                                      | 2.0          | —                   | 0.0  | 0.1                 | —                   |           |    |  |
|                           |          |                               | $I_{OL} = 4 mA$<br>$I_{OL} = 8 mA$   | 3.0          | —                   | 0.0  | 0.1                 | —                   |           |    |  |
|                           |          |                               |                                      | 4.5          | —                   | 0.0  | 0.1                 | —                   |           |    |  |
| Input leakage current     | $I_{IN}$ | $V_{IN} = 5.5$ V or GND       |                                      | 0 to 5.5     | —                   | —    | $\pm 0.1$           | —                   | $\pm 1.0$ | μA |  |
| Quiescent supply current  | $I_{CC}$ | $V_{IN} = V_{CC}$ or GND      |                                      | 5.5          | —                   | —    | 2.0                 | —                   | 20.0      | μA |  |

Timing Requirements (input:  $t_r = t_f = 3$  ns)

| Characteristics  | Symbol    | Test Condition | Ta = 25°C           | Ta = -40 to 85°C | Unit |
|--|-----------|----------------|---------------------|------------------|------|
|  |           |                | V <sub>CC</sub> (V) | Limit            |      |
| Minimum pulse width<br>(CK)                                    | $t_w$ (L) | —              | 3.3 ± 0.3           | 6.0              | 7.0  |
|  | $t_w$ (H) |                | 5.0 ± 0.5           | 5.0              | 5.0  |
| Minimum pulse width<br>( $\overline{CLR}$ , $\overline{PR}$ )  | $t_w$ (L) | —              | 3.3 ± 0.3           | 6.0              | 7.0  |
|  |           |                | 5.0 ± 0.5           | 5.0              | 5.0  |
| Minimum set-up time  | $t_s$     | —              | 3.3 ± 0.3           | 6.0              | 7.0  |
|  |           |                | 5.0 ± 0.5           | 5.0              | 5.0  |
| Minimum hold time  | $t_h$     | —              | 3.3 ± 0.3           | 0.5              | 0.5  |
|  |           |                | 5.0 ± 0.5           | 0.5              | 0.5  |
| Minimum removal time<br>( $\overline{CLR}$ , $\overline{PR}$ ) | $t_{rem}$ | —              | 3.3 ± 0.3           | 5.0              | 5.0  |
|  |           |                | 5.0 ± 0.5           | 3.0              | 3.0  |

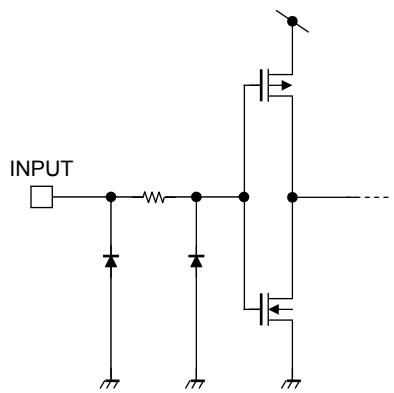
AC Characteristics (input:  $t_r = t_f = 3$  ns)

| Characteristics                                   | Symbol          | Test Condition      |                     | Ta = 25°C |      |      | Ta = -40 to 85°C |     | Unit |  |
|---|-----------------|---------------------|---------------------|-----------|------|------|------------------|-----|------|--|
|   |                 | V <sub>CC</sub> (V) | C <sub>L</sub> (pF) | Min       | Typ. | Max  | Min              | Max |      |  |
| Propagation delay time<br>(CK-Q, $\overline{Q}$ ) | $t_{pLH}$       | —                   | 3.3 ± 0.3           | 15        | —    | 6.7  | 11.9             | 1.0 | 14.0 |  |
|   |                 |                     |                     | 50        | —    | 9.2  | 15.4             | 1.0 | 17.5 |  |
|   |                 |                     | 5.0 ± 0.5           | 15        | —    | 4.6  | 7.3              | 1.0 | 8.5  |  |
|   |                 |                     |                     | 50        | —    | 6.1  | 9.3              | 1.0 | 10.5 |  |
|   | $t_{pHL}$       | —                   | 3.3 ± 0.3           | 15        | —    | 7.6  | 12.3             | 1.0 | 14.5 |  |
|   |                 |                     |                     | 50        | —    | 10.1 | 15.8             | 1.0 | 18.0 |  |
|   |                 |                     | 5.0 ± 0.5           | 15        | —    | 4.8  | 7.7              | 1.0 | 9.0  |  |
|   |                 |                     |                     | 50        | —    | 6.3  | 9.7              | 1.0 | 11.0 |  |
| Maximum clock frequency                           | $f_{max}$       | —                   | 3.3 ± 0.3           | 15        | 80   | 125  | —                | 70  | MHz  |  |
|   |                 |                     |                     | 50        | 50   | 75   | —                | 45  |      |  |
|   |                 |                     | 5.0 ± 0.5           | 15        | 130  | 170  | —                | 110 |      |  |
|   |                 |                     |                     | 50        | 90   | 115  | —                | 75  |      |  |
| Input capacitance                                 | C <sub>IN</sub> | —                   |                     | —         | 4    | 10   | —                | 10  | pF   |  |
| Power dissipation capacitance                     | C <sub>PD</sub> | (Note)              |                     |           | —    | 25   | —                | —   | 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:

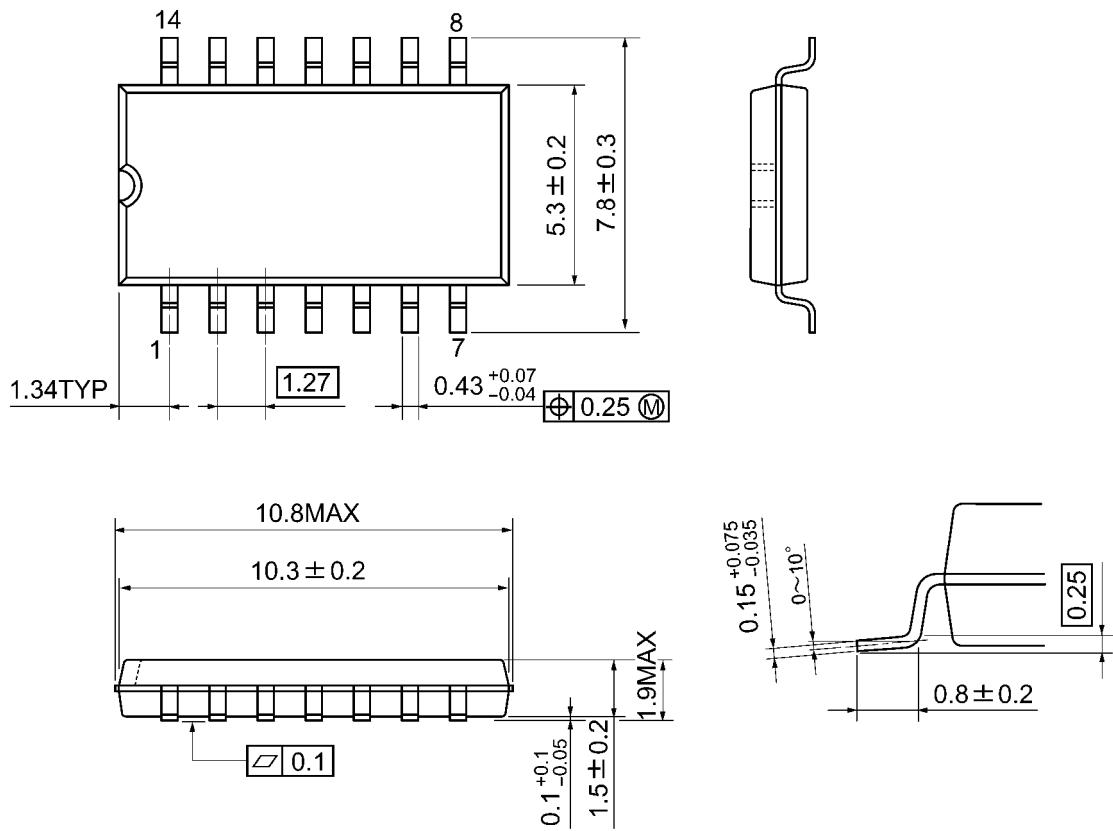
$$I_{CC(\text{opr})} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2 \text{ (per F/F)}$$

**Input Equivalent Circuit**

**Package Dimensions**

SOP14-P-300-1.27A

Unit: mm

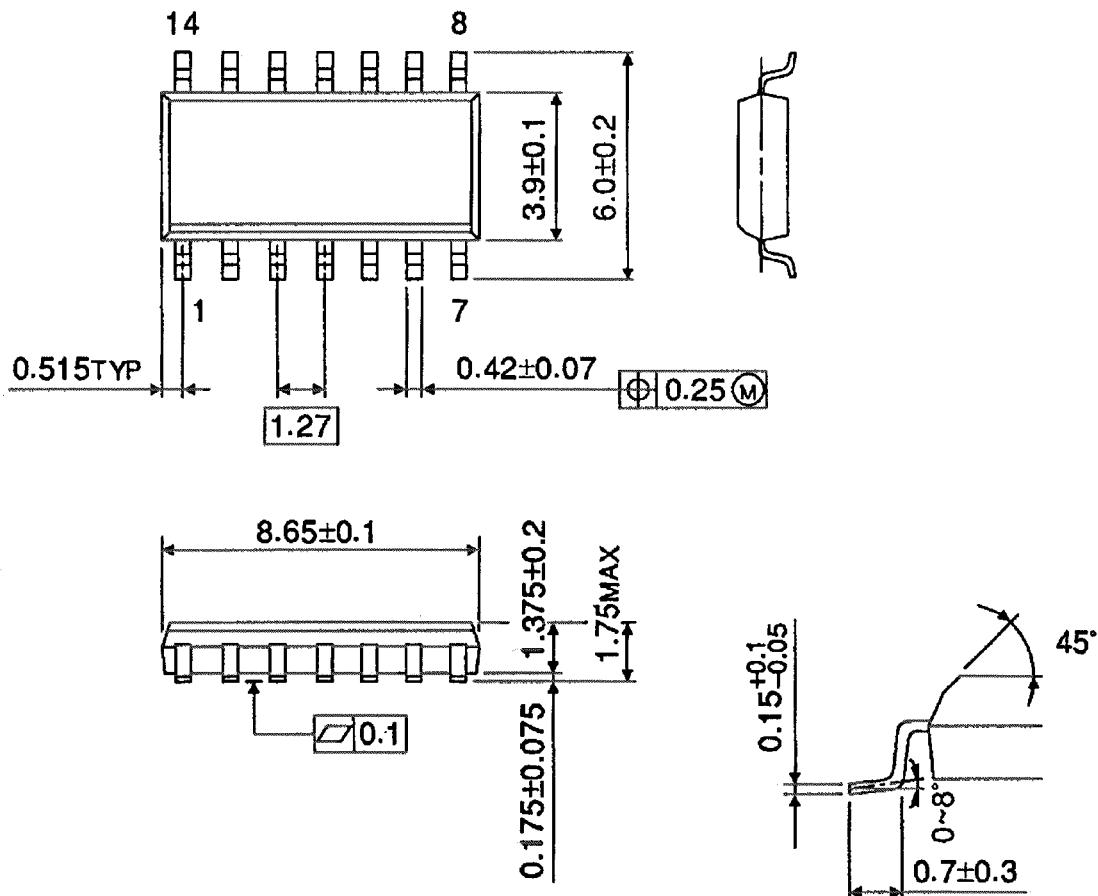


Weight: 0.18 g (typ.)

**Package Dimensions (Note)**

SOL14-P-150-1.27

Unit : mm



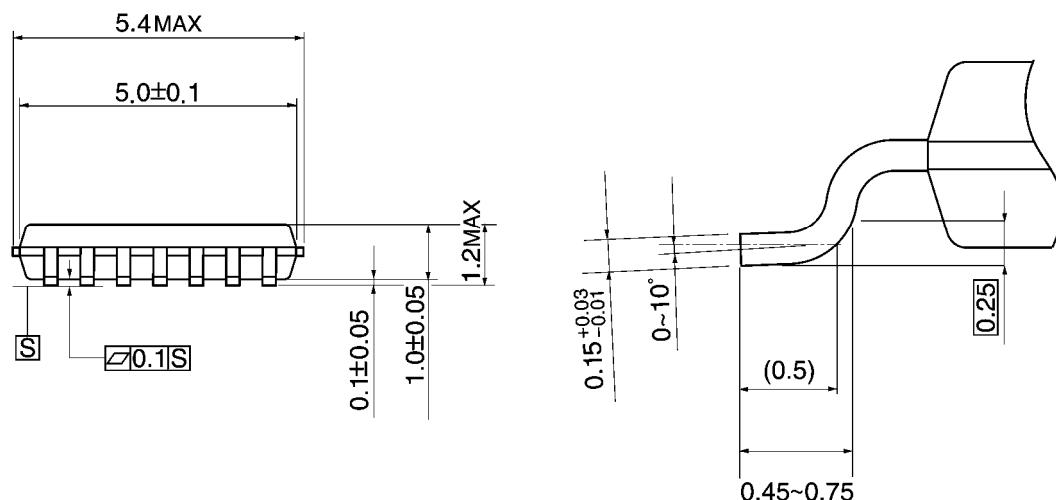
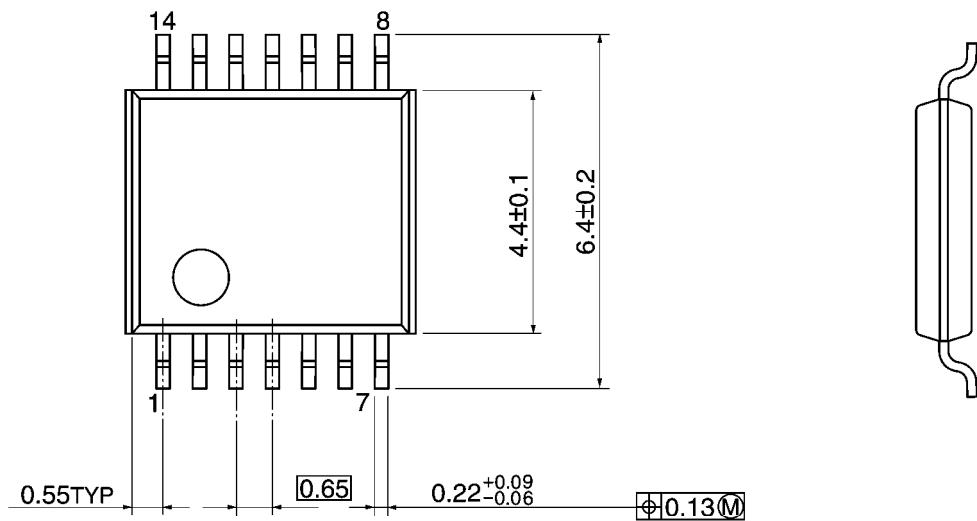
Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

**Package Dimensions**

TSSOP14-P-0044-0.65A

Unit: mm

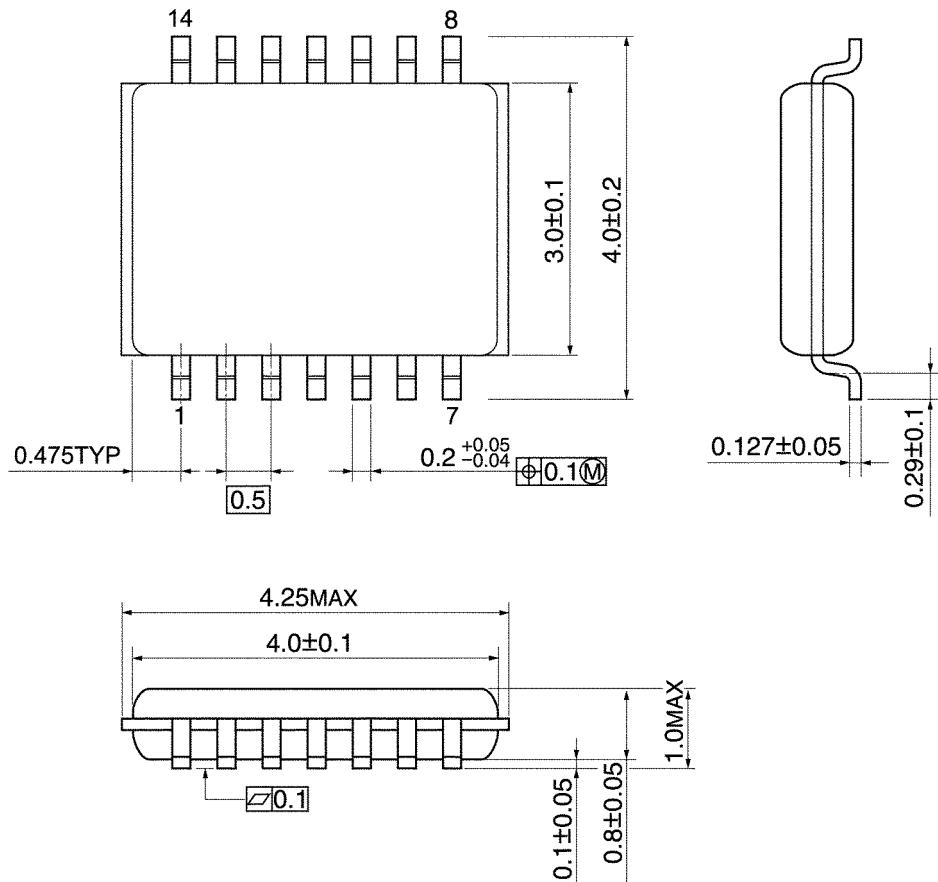


Weight: 0.06 g (typ.)

**Package Dimensions**

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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