

**TC74VHC14F, TC74VHC14FT, TC74VHC14FK****Hex Schmitt Inverter**

The TC74VHC14 is an advanced high speed CMOS SCHMITT INVERTER 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.

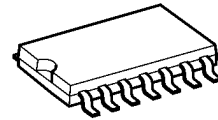
Pin configuration and function are the same as the TC74VHC04 but the inputs have hysteresis and with its schmitt trigger function, the TC74VHC14 can be used as a line receivers which will receive slow input signals.

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**

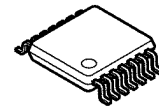
- High speed:  $t_{pd} = 5.5 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 2 \text{ } \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- Power down protection is provided on all inputs.
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC (opr)} = 2 \text{ V to } 5.5 \text{ V}$
- Low noise:  $V_{OLP} = 0.8 \text{ V (max)}$
- Pin and function compatible with 74ALS14

TC74VHC14F



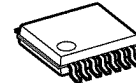
SOP14-P-300-1.27A

TC74VHC14FT



TSSOP14-P-0044-0.65A

TC74VHC14FK

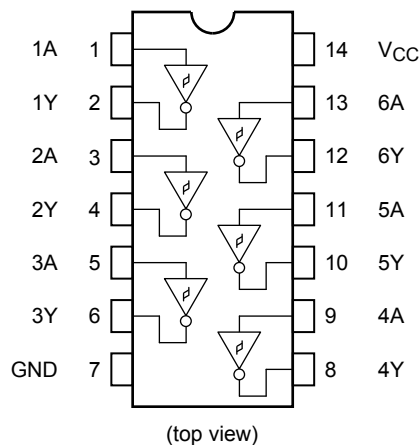


VSSOP14-P-0030-0.50

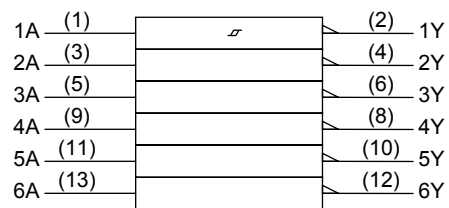
**Weight**

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

## Pin Assignment



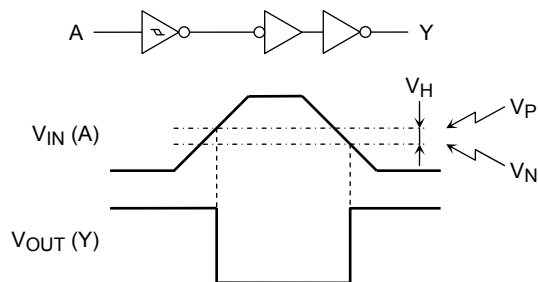
## IEC Logic Symbol



## Truth Table

| A | Y |
|---|---|
| L | H |
| H | L |

## System Diagram, Waveform



## 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   |

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  | Max  |
| Positive threshold voltage | $V_P$    | —                                | —                        | 3.0          | —    | —    | 2.20             | —    | 2.20 |
|                            |          |                                  |                          | 4.5          | —    | —    | 3.15             | —    | 3.15 |
|                            |          |                                  |                          | 5.5          | —    | —    | 3.85             | —    | 3.85 |
| Negative threshold voltage | $V_N$    | —                                | —                        | 3.0          | 0.90 | —    | —                | 0.90 | —    |
|                            |          |                                  |                          | 4.5          | 1.35 | —    | —                | 1.35 | —    |
|                            |          |                                  |                          | 5.5          | 1.65 | —    | —                | 1.65 | —    |
| Hysteresis voltage         | $V_H$    | —                                | —                        | 3.0          | 0.30 | —    | 1.20             | 0.30 | 1.20 |
|                            |          |                                  |                          | 4.5          | 0.40 | —    | 1.40             | 0.40 | 1.40 |
|                            |          |                                  |                          | 5.5          | 0.50 | —    | 1.60             | 0.50 | 1.60 |
| High-level output voltage  | $V_{OH}$ | $V_{IN} = V_{IL}$                | $I_{OH} = -50 \mu A$     | 2.0          | 1.9  | 2.0  | —                | 1.9  | —    |
|                            |          |                                  |                          | 3.0          | 2.9  | 3.0  | —                | 2.9  | —    |
|                            |          |                                  |                          | 4.5          | 4.4  | 4.5  | —                | 4.4  | —    |
|                            |          |                                  | $I_{OH} = -4 \text{ mA}$ | 3.0          | 2.58 | —    | —                | 2.48 | —    |
| Low-level output voltage   | $V_{OL}$ | $V_{IN} = V_{IH}$                | $I_{OL} = 50 \mu A$      | 2.0          | —    | 0.0  | 0.1              | —    | 0.1  |
|                            |          |                                  |                          | 3.0          | —    | 0.0  | 0.1              | —    | 0.1  |
|                            |          |                                  |                          | 4.5          | —    | 0.0  | 0.1              | —    | 0.1  |
|                            |          |                                  | $I_{OL} = 4 \text{ mA}$  | 3.0          | —    | —    | 0.36             | —    | 0.44 |
| Input leakage current      | $I_{IN}$ | $V_{IN} = 5.5 \text{ V or GND}$  | —                        | 0 to 5.5     | —    | —    | ±0.1             | —    | ±1.0 |
|                            |          |                                  |                          | 5.5          | —    | —    | 2.0              | —    | 20.0 |
| Quiescent supply current   | $I_{CC}$ | $V_{IN} = V_{CC} \text{ or GND}$ | —                        | 5.5          | —    | —    | 2.0              | —    | 20.0 |

## AC Characteristics (input: $t_r = t_f = 3 \text{ ns}$ )

| Characteristics               | Symbol                               | Test Condition |                     |                     | Ta = 25°C |      |      | Ta =<br>-40 to 85°C |      | Unit |
|-------------------------------|--------------------------------------|----------------|---------------------|---------------------|-----------|------|------|---------------------|------|------|
|                               |                                      |                | V <sub>CC</sub> (V) | C <sub>L</sub> (pF) | Min       | Typ. | Max  | Min                 | Max  |      |
| Propagation delay time        | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 3.3 ± 0.3           | 15                  | —         | 8.3  | 12.8 | 1.0                 | 15.0 | ns   |
|                               |                                      |                |                     | 50                  | —         | 10.8 | 16.3 | 1.0                 | 18.5 |      |
|                               |                                      |                | 5.0 ± 0.5           | 15                  | —         | 5.5  | 8.6  | 1.0                 | 10.0 |      |
|                               |                                      |                |                     | 50                  | —         | 7.0  | 10.6 | 1.0                 | 12.0 |      |
| Input capacitance             | C <sub>IN</sub>                      | —              |                     |                     | —         | 4    | 10   | —                   | 10   | pF   |
| Power dissipation capacitance | C <sub>PD</sub>                      | (Note)         |                     |                     | —         | 21   | —    | —                   | —    | 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.

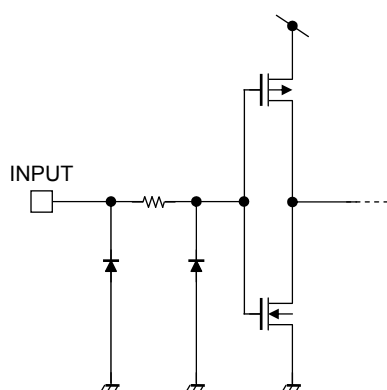
Average operating current can be obtained by the equation:

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

## Noise Characteristics (input: $t_r = t_f = 3 \text{ ns}$ )

| Characteristics                              | Symbol           | Test Condition         |                     | Ta = 25°C |       | Unit |
|----------------------------------------------|------------------|------------------------|---------------------|-----------|-------|------|
|                                              |                  |                        | V <sub>CC</sub> (V) | Typ.      | Limit |      |
| Quiet output maximum dynamic V <sub>OL</sub> | V <sub>OLP</sub> | C <sub>L</sub> = 50 pF | 5.0                 | 0.4       | 0.8   | V    |
| Quiet output minimum dynamic V <sub>OL</sub> | V <sub>OLV</sub> | C <sub>L</sub> = 50 pF | 5.0                 | -0.4      | -0.8  | V    |
| Minimum high level dynamic input voltage     | V <sub>IHD</sub> | C <sub>L</sub> = 50 pF | 5.0                 | —         | 3.5   | V    |
| Maximum low level dynamic input voltage      | V <sub>ILD</sub> | C <sub>L</sub> = 50 pF | 5.0                 | —         | 1.5   | V    |

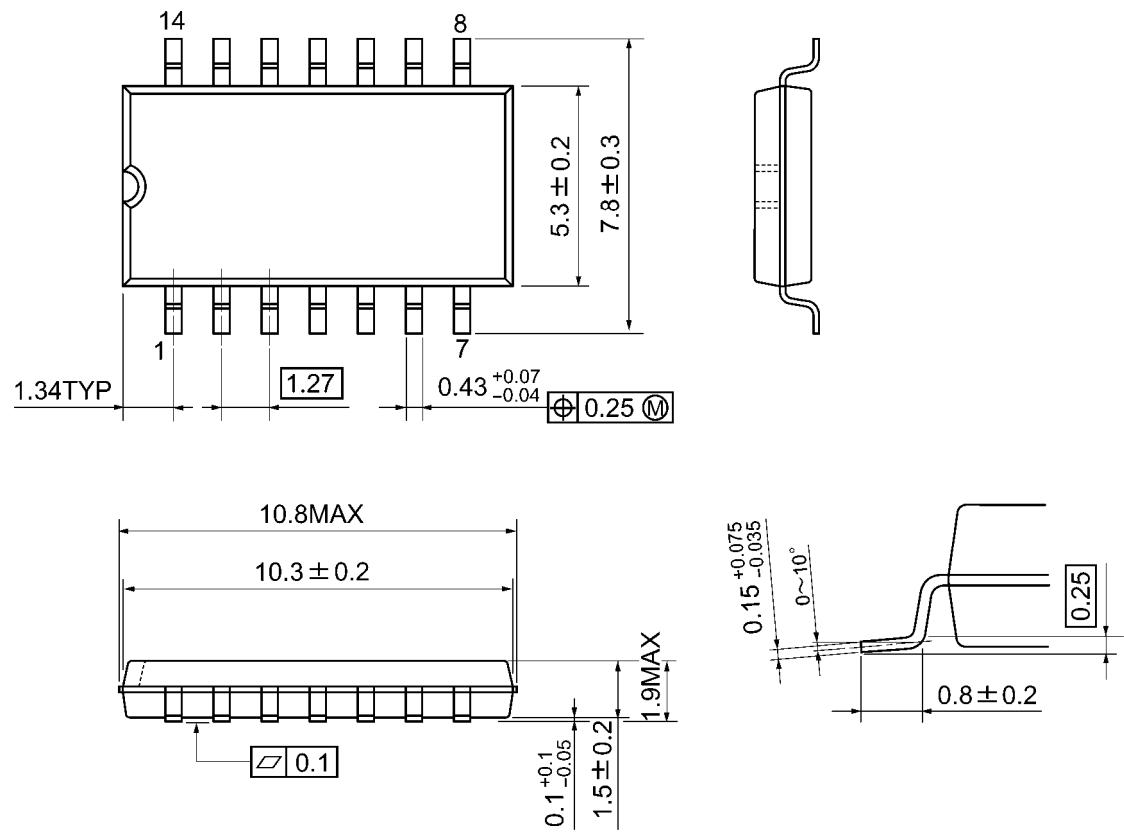
## Input Equivalent Circuit



Package Dimensions

SOP14-P-300-1.27A

Unit: mm

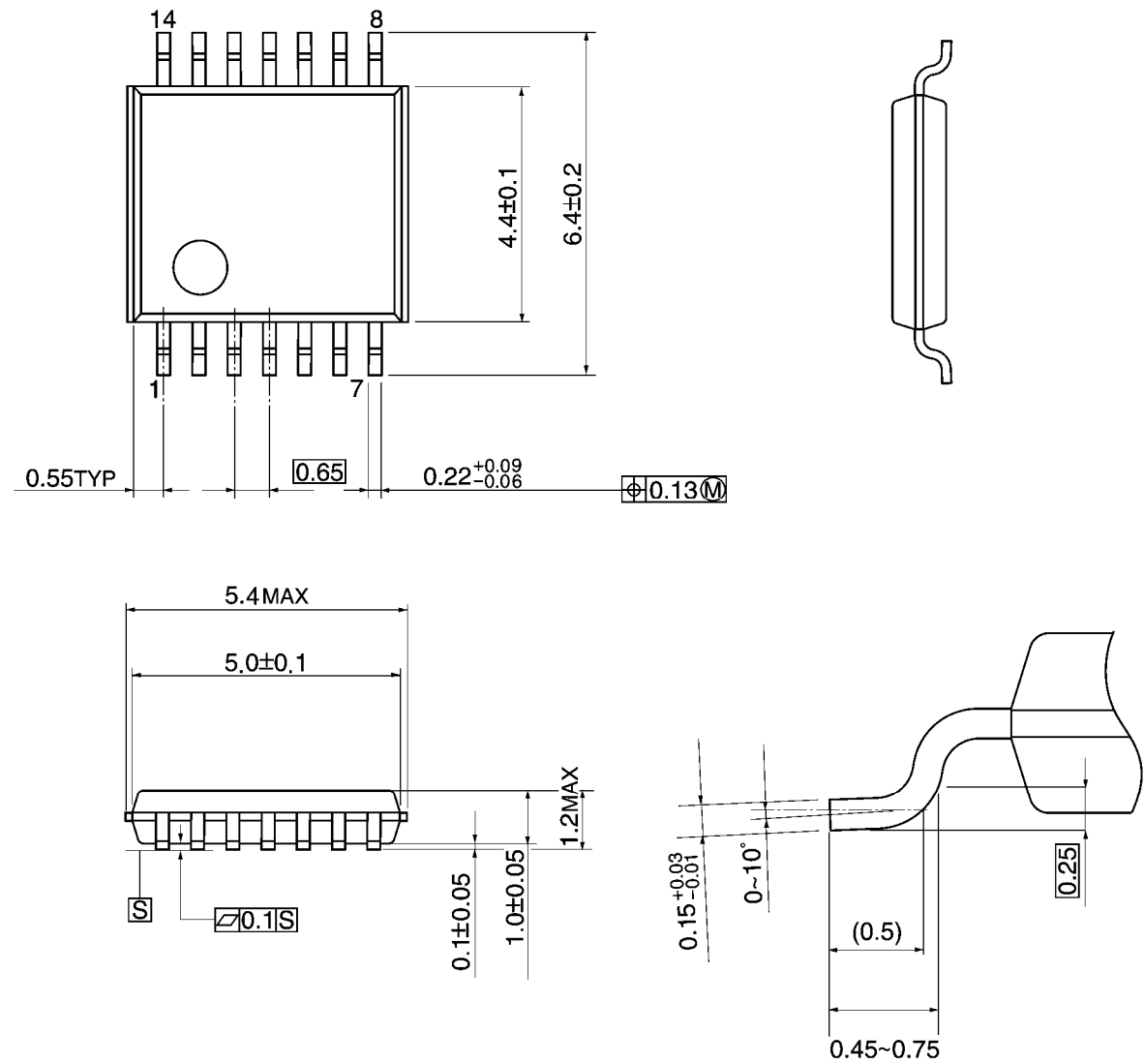


Weight: 0.18 g (typ.)

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm

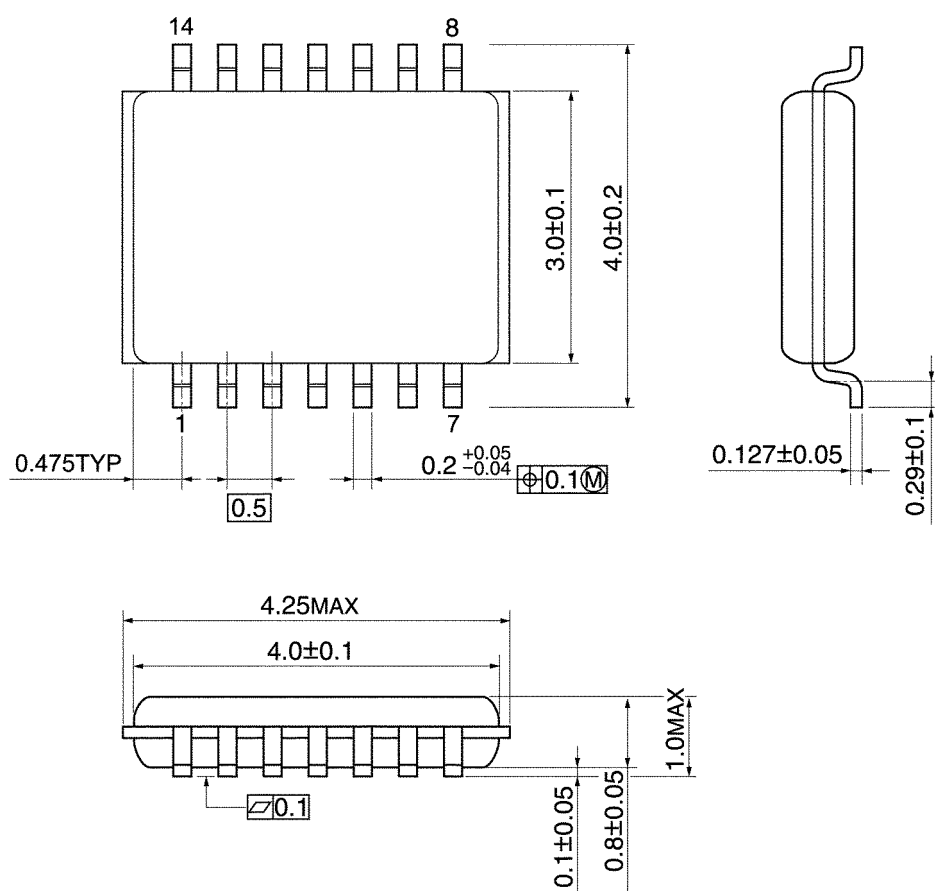


Weight: 0.06 g (typ.)

## Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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