

TC74VHCU04F, TC74VHCU04FT

Hex Inverter

The TC74VHCU04 is an advanced high speed CMOS INVERTER fabricated with silicon gate C²MOS technology.

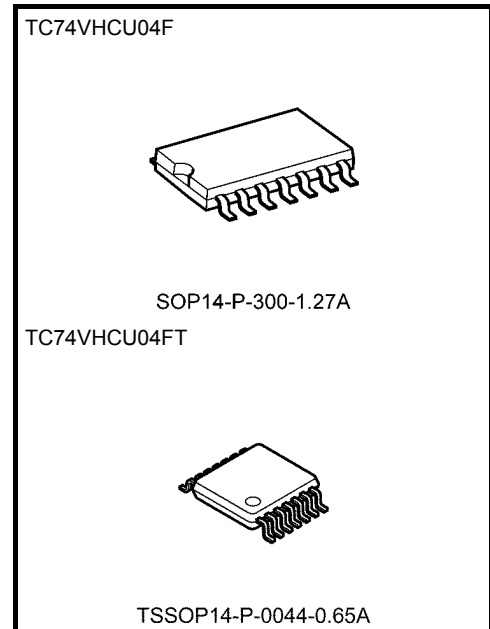
It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

Since the internal circuit is composed of a single stage inverter, it can be used in analog applications such as crystal oscillators.

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

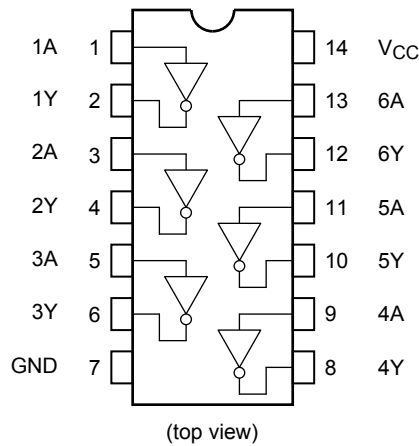
- High speed: $t_{pd} = 3.5 \text{ ns}$ (typ.) at $V_{CC} = 5 \text{ V}$
- Low power dissipation: $I_{CC} = 2 \mu\text{A}$ (max) at $T_a = 25^\circ\text{C}$
- High noise immunity: $V_{NIH} = V_{NIL} = 10\% V_{CC}$ (min)
- Power down protection is provided on all inputs.
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC} (\text{opr}) = 2 \text{ V to } 5.5 \text{ V}$
- Low noise: $V_{OLP} = 0.8 \text{ V}$ (max)
- Pin and function compatible with 74ALS04



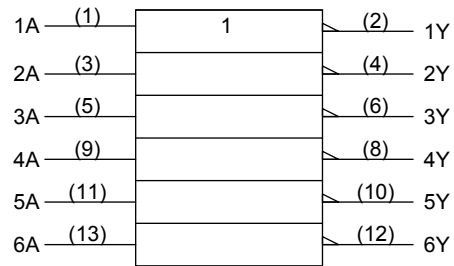
| | |
|----------------------|-----------------|
| Weight | |
| SOP14-P-300-1.27A | : 0.18 g (typ.) |
| TSSOP14-P-0044-0.65A | : 0.06 g (typ.) |

Start of commercial production
1991-07

Pin Assignment



IEC Logic Symbol



Truth Table

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

Absolute Maximum Ratings (Note)

| Characteristics | Symbol | Rating | Unit |
|-----------------------------|-----------|------------------------|-------------|
| Supply voltage range | V_{CC} | -0.5 to 7.0 | V |
| DC input voltage | V_{IN} | -0.5 to 7.0 | V |
| DC output voltage | V_{OUT} | -0.5 to $V_{CC} + 0.5$ | V |
| Input diode current | I_{IK} | -20 | mA |
| Output diode current | I_{OK} | ± 20 | mA |
| DC output current | I_{OUT} | ± 25 | mA |
| DC V_{CC} /ground current | I_{CC} | ± 50 | mA |
| Power dissipation | P_D | 180 | mW |
| Storage temperature | T_{stg} | -65 to 150 | $^{\circ}C$ |

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 | $^{\circ}C$ |

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 | | |
|---------------------------|-----------------|--|--|-------------------|-------------------------------|-------------------|-------------------------------|-------------------------------|-------------------------------|----|---|
| | | | | Min | Typ. | Max | Min | Max | | | |
| High-level input voltage | V _{IH} | V _{OUT} = V _{OL} | | 2.0 3.0 to 5.5 | 1.70 V _{CC} × 0.8 | — — | — — | 1.70 V _{CC} × 0.8 | — — | V | |
| Low-level input voltage | V _{IL} | V _{OUT} = V _{OH} | | 2.0 3.0 to 5.5 | — — | — — | 0.30 V _{CC} × 0.2 | — — | 0.30 V _{CC} × 0.2 | V | |
| High-level output voltage | V _{OH} | V _{IN} = V _{IL} | I _{OH} = -50 μA | 2.0 3.0 4.5 | 1.8 2.7 4.0 | 2.0 3.0 4.5 | — — — | 1.8 2.7 4.0 | — — — | V | |
| | | | I _{OH} = -4 mA I _{OH} = -8 mA | 3.0 4.5 | 2.58 3.94 | — — | — — | 2.48 3.80 | — — | | |
| | | V _{IN} = GND | I _{OL} = 50 μA | 2.0 3.0 4.5 | — — — | 0.0 0.0 0.0 | 0.2 0.3 0.5 | — — — | 0.2 0.3 0.5 | | V |
| | | | I _{OL} = 4 mA I _{OL} = 8 mA | 3.0 4.5 | — — | — — | 0.36 0.36 | — — | 0.44 0.44 | | |
| Input leakage current | I _{IN} | V _{IN} = 5.5 V or GND | | 0 to 5.5 | — | — | ±0.1 | — | ±1.0 | μA | |
| Quiescent supply current | I _{CC} | V _{IN} = V _{CC} or GND | | 5.5 | — | — | 2.0 | — | 20.0 | μA | |

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

| Characteristics | Symbol | Test Condition | | Ta = 25°C | | | Ta = -40 to 85°C | | Unit | |
|-------------------------------|------------------|----------------|-----------|-----------|------|-----|------------------|-----|------|----|
| | | | | Min | Typ. | Max | Min | Max | | |
| Propagation delay time | t _{pLH} | — | 3.3 ± 0.3 | 15 | — | 5.0 | 8.9 | 1.0 | 10.5 | ns |
| | | | | 50 | — | 7.5 | 11.4 | 1.0 | 13.0 | |
| | t _{pHL} | — | 5.0 ± 0.5 | 15 | — | 3.5 | 5.5 | 1.0 | 6.5 | |
| | | | | 50 | — | 5.0 | 7.0 | 1.0 | 8.0 | |
| Input capacitance | C _{IN} | — | | — | 4 | 10 | — | 10 | pF | |
| Power dissipation capacitance | C _{PD} | (Note) | | — | 9 | — | — | — | pF | |

Note: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

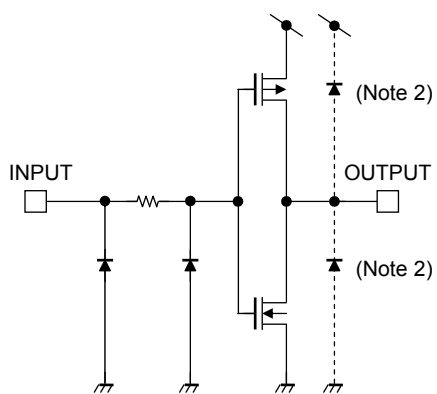
Average operating current can be obtained by the equation:

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

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

| Characteristics | Symbol | Test Condition | | Ta = 25°C | | Unit |
|--|------------------|------------------------|---------------------|-----------|------|------|
| | | | V _{CC} (V) | Typ. | Max | |
| Quiet output maximum dynamic V _{OL} | V _{OLP} | C _L = 50 pF | 5.0 | 0.5 | 0.8 | V |
| Quiet output minimum dynamic V _{OL} | V _{OLV} | C _L = 50 pF | 5.0 | -0.5 | -0.8 | V |
| Minimum high level dynamic input voltage | V _{IHD} | C _L = 50 pF | 5.0 | — | 4.0 | V |
| Maximum low level dynamic input voltage | V _{ILD} | C _L = 50 pF | 5.0 | — | 1.0 | V |

Input Equivalent Circuit



Note 2: Parasitic diode

Package Dimensions

SOP14-P-300-1.27A

Unit: mm

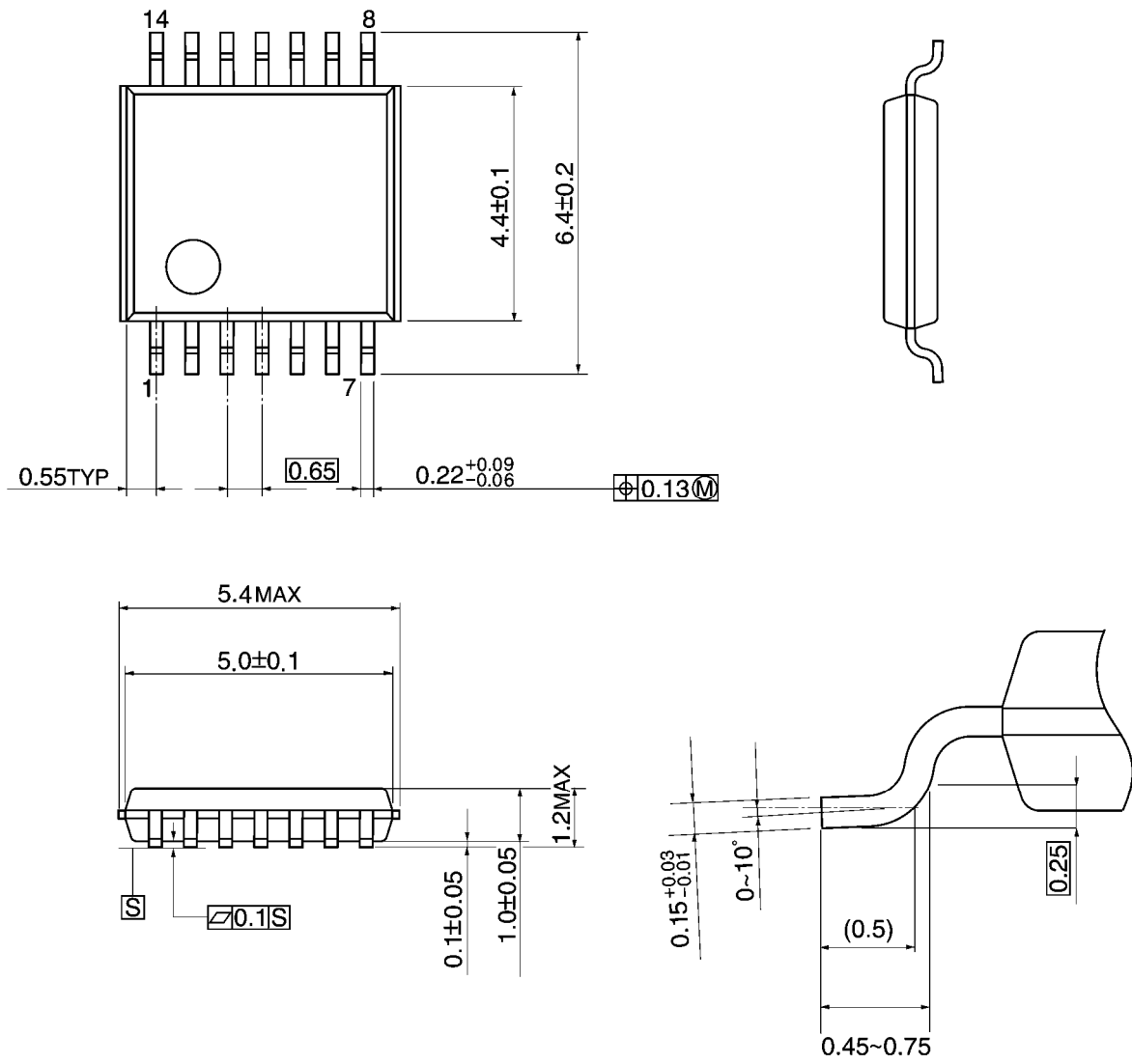


Weight: 0.18 g (typ.)

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

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